AIR FORCE SPACE COMMAND

Volume 2, Number 4

HIGH FRONTIER

THE JOURNAL FOR SPACE & MISSILE PROFESSIONALS

U.S. AIR FORCE

The Future of Strategic Deterrence and the Intercontinental Ballistic Missile

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
AUG 2006		**00-00-2006 to 00-00-2006**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
High Frontier. The Journal for Space & Missile Professionals. Volume 2, Number 4, August 2006	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Air Force Space Command (AFSPC/PAI),150 Vandenberg St Ste 1105,Peterson AFB,CO,80914**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**68**	

Headquarters
Air Force
Space Command
Peterson Air Force Base, Colorado

Commander
General Kevin P. Chilton

Director of Public Affairs
Col Les Kodlick

Creative Editor
Ms. Nadine Sage

Published by a private firm in no way connected with the US Air Force, under exclusive written contract with Air Force Space Command. This command funded Air Force journal is an authorized publication for members of the United States military Services. Contents of *High Frontier* are not necessarily the official views of, or endorsed by, the US Government, the Department of Defense, or the Department of the Air Force.

Editorial content is edited, prepared, and provided by the Public Affairs Office of Air Force Space Command. All photographs are Air Force photographs unless otherwise indicated.

High Frontier, Air Force Space Command's premier space professional journal, will be published quarterly. The journal provides a scholarly forum for professionals to exchange knowledge and ideas on space-related issues throughout the space community. The journal focuses primarily on Air Force and Department of Defense space programs; however, the *High Frontier* staff welcomes submissions from within the space community. Comments, inquiries, and article submissions should be sent to AFSPC.PAI@peterson.af.mil. They can also be mailed to:

AFSPC/PAI
150 Vandenberg St. Ste 1105
Peterson AFB, CO 80914
Telephone: (719) 554-3978
Fax: (719) 554-6013

For more information on space professional development visit:
http://www.afspc.af.mil/

To subscribe: nsage@colsa.com

COVER: Air Force ICBMs deployed over five decades were critical to winning the Cold War and vital to assuring United States security and well-being in the 21st century.

HIGH FRONTIER

The Journal for Space & Missile Professionals

August 2006 Volume 2, Number 4

Contents

Next Issue: ***Assured Access to Space***

Introduction

Strategic Deterrence in the Post Cold War/911 Era

General Kevin P. Chilton
Commander, Air Force Space Command

"We maintain our strength in order to deter and defend against aggression—to preserve freedom and peace."
- Ronald Reagan

The quality of the *High Frontier* journal is a reflection of the great work of its contributors. Each of them deserves our thanks for a job well done. The submissions to our editorial board have once again exceeded expectations. In addition to covering the full spectrum of issues related to strategic deterrence we have also included articles on other topics critical to support of the joint warfighter and space professional development. These articles represent the dialogue we strive to foster in this journal and our continuing promise to facilitate the intellectual debate surrounding our Nation's space and missile capabilities.

It is particularly appropriate that a complete edition of the *High Frontier* is dedicated to the topic of strategic deterrence. After all, we trace our heritage directly back to those early pioneers, visionaries like General "Bennie" Schriever and his entire "Schoolhouse Gang," who pioneered intercontinental ballistic missile (ICBM) technology and the operational concepts that made our ICBMs a key leg of our Nation's strategic deterrent force. Beginning with the development of the Atlas missile in the 1950s, the ICBM force and its people helped guard against major attacks on the United States, its forces abroad, and our friends and allies. But today we find the "Cold War triad" subsumed into a "new triad" intended to deter threats presented not only by potential adversaries with sophisticated military capabilities, but also by non-state actors and terrorist groups. What role does Air force Space Command (AFSPC) play in this new environment?

Literally defined, deterrence is the maintenance of military power for the purpose of discouraging attack. To deter aggression, one must possess both the capability to respond to a threat of attack and the clear will to employ that capability. An adversary that believes this to be the case and calculates that the risks and cost of carrying out an attack far outweigh any conceivable gain will be deterred from doing so. The US strategy of nuclear deterrence was ultimately validated when the Cold War ended without major conflict between the opposing sides.

Even prior to the events of 11 September 2001 we had already begun to re-look the triad that had served us so well in the past. Our current, or "new triad," is outlined in the Nuclear Posture Review. As it will be described in greater detail within this journal, it is comprised of offensive capabilities, defensive capabilities, and a responsive defense infrastructure, all enabled by persistent global command and control (C2), intelligence, and agile planning systems. This "new triad" has significantly expanded AFSPC's role. Not only are we required to maintain our nuclear ICBM and Missile Warning capability to support the offense point of this triangle, but our Missile Warning, C2, and planning systems are further challenged to support the defensive point of the triangle that missile defense systems provide. At AFSPC, we take our stewardship of these key elements of the "new triad" very seriously.

As several articles in this journal will illustrate, the US strategic deterrent force has been reduced, and continues to be reduced, in response to the changing strategic environment. For our part, we in AFSPC recently deactivated the Peacekeeper ICBM. Additionally, the Quadrennial Defense Review has directed a reduction of deployed Minuteman III ballistic missiles from 500 to 450, beginning in Fiscal Year 2007. This reduction in the size of our on-alert ICBM force does not diminish the importance of this weapon system. The need for strategic deterrence has not gone away, particularly given the possibility that additional nations could develop and field weapons of mass destruction, as well as the means to deliver them. The United States still must deter potential adversaries with the combination of our capability and the will to use that capability in self defense. For this reason, we in AFSPC continue to have the responsibility of maintaining the ICBM leg of our Nation's strategic deterrent capability. To that end, we are pursuing a comprehensive program to modernize and maintain the Minuteman ICBM force as an effective and secure weapon system through the year 2020. We are also committed to making sure the men and women who operate, maintain, secure, and support our ICBM force, have the training, professional development, and quality of life they need to carry out their awesome responsibilities.

In support of the missile defense mission we provide the Nation's first line of defense in the form of space and ground-based early warning capabilities. This vital portion of the strategic deterrence umbrella has kept watch over our Nation for decades and now it must do more than keep watch. It must detect, track, and hand off essential data to our missile defense systems. Along with our ICBMs, we must continue to upgrade these systems to meet emerging ballistic missile threats. The Defense Support Program (DSP) has been a model of war-fighting effectiveness for decades and exceeded all expectations, but its life span is not infinite. As good stewards of this capability, we remain absolutely determined to recapitalizing the DSP constellation. We are focused on successfully fielding the Space Based Infrared System as well as upgrading our early warning radar sites. These modernization and recapitalization efforts will ensure our missile warning capability serves its critical role in strategic deterrence well into the future.

The "new triad" also demands improved flexibility in dealing with a wider range of contingencies, while reducing our dependence on nuclear weapons in order to assure our allies, dissuade competitors, and deter those who plan to harm us, particularly with weapons of mass destruction. This is a call to provide the President with a wider, more flexible range of options. A prompt, precise conventional global strike capability is one such alternative. Known as Prompt Global Strike (PGS), this quick reaction capability would enable us to hold time sensitive targets at risk within the same timelines that our nuclear-tipped ICBM forces can respond today—but with conventional warheads. There may also be effective non-kinetic means of holding future adversaries at risk with consequences that are unacceptable to them. We must pursue these as well. Either would give the President courses of action between the use of nuclear weapons and a precise but less timely conventional cruise missile or gravity weapon strike.

The capability to strike fleeting targets with PGS or to deliver timely non-kinetic effects will be dependant on our ability to operate inside the adversary's decision cycle. The importance of effective intelligence, C2, and agile planning systems are further magnified as decision cycles become more compressed. Many of the non-traditional adversaries we face will not be deterred by the threat of a tardy response on our part regardless of the speed of our weapons. They must know that we possess the capability to strike them at any time, at any place, and with whatever degree of force our national leaders choose. Combined with the will to use such force, we present the opportunity to deter future adversaries just as successfully as we deterred nuclear aggression and major attacks over the last half century.

Finally, in today's post 9/11 world, we must also address the prospect of an adversary that recognizes our capability and will to execute, but professes to not fear the consequences of any attack we might mount. How do we deter the non-state actor that claims no fear of death and has no loyalty to the preservation of any nation-state? Certainly this is one of the challenges we face today in the Global War on Terror and it is a problem that I commend to the professionals within AFSPC to ponder. In this issue of *High Frontier,* we hope to stimulate your thoughts on strategic deterrence, to think beyond the accepted definitions and carefully crafted scenarios, and challenge yourself to answer not only today's questions but also tomorrow's!

Space Professional Development

Through the *High Frontier* Journal, we want to expose you to diverse viewpoints, and stimulate some fresh ideas on how we can execute our missions. Our goal is to receive articles by AFSPC's professionals, warfighters who employ space capabilities and everyone who has an interest in national security space issues.

Over the last year, the *High Frontier* Journal has grown into the premier source for intellectual debate on the space and missile missions, and this issue heightens our awareness of a core AFSPC mission area, force application. The next year promises several stimulating issues of the *High Frontier*. Our topics for the following four issues are:

November 2006: Assured Access to Space
February 2007: International Space and Missile Policy
May 2007: Space Innovation
August 2007: AFSPC Anniversary Issue (25 Yrs)

As you read this month's journal, I invite you to consider your own viewpoints on today's military space challenges. I encourage you to reflect on how your contributions to this dynamic field can enhance our ability to provide the necessary space support to combatant commanders. Your fresh and innovative ideas are critical to our ability to remain the world's premier air and space force.

General Kevin P. Chilton (BS Engineering Science, USAFA; MS, Mechanical Engineering, Columbia University) is Commander, Air Force Space Command, Peterson Air Force Base, Colorado. He is responsible for the development, acquisition and operation of the Air Force's space and missile systems. The command oversees a global network of satellite command and control, communications, missile warning and launch facilities, and ensures the combat readiness of America's intercontinental ballistic missile force. The command comprises more than 39,700 space professionals who provide combat forces and capabilities to North American Aerospace Defense Command and US Strategic Command.

General Chilton was a pilot and flew operational assignments in RF-4Cs and F-15s. From 1988 to 1996, he was an astronaut for NASA and is a veteran of three space shuttle missions, logging over 704 hours in space. He was a wing commander, acted as assistant Vice Chief of Staff, and served as Commander of 8th Air Force and Joint Functional Component Commander for Space and Global Strike, US Strategic Command, prior to his current position. General Chilton is the first astronaut to achieve 4-star rank from any military service.

Intercontinental Ballistic Missiles in the Twenty-First Century

Mr. Franklin C. Miller
Vice President, The Cohen Group

The Cold War has been over for almost a decade and a half. The Soviet Union is gone. Russia is not an enemy. The Treaty of Moscow will reduce our strategic nuclear arsenal to its lowest level in decades. The "old triad" has been subsumed into a "new triad." We are currently engaged in a global war on terrorism and, with good reason, we worry more about terrorists gaining access to weapons of mass destruction than we do about deterring a massive nuclear attack. Amidst all this change, many have questioned if there is a meaningful role for the United States intercontinental ballistic missile (ICBM) force to play in the twenty first century. Indeed, some have asked if there is any role for nuclear weapons and nuclear deterrence in the future. The simple answer to these questions, now as in the past, is "yes." The United States will continue to need and deploy a nuclear deterrent for the foreseeable future. It will continue to need and deploy a strategic nuclear triad, in which there is a critical role to be played by the Air Force's ICBMs.

Nuclear Deterrence in the Twenty First Century

The end of the Cold War did not eliminate potential military threats to the United States or to our allies, nor did it eliminate the knowledge and capability to build nuclear weapons. There are, unfortunately, some governments around the world which do not wish us well and have the capability to do us harm—and might do so if they did not fear our response. The past fifteen years also have borne witness to the fact that rogue states continue to seek to develop nuclear weapons and to marry these with their programs to field long-range ballistic missiles. So, the world remains a dangerous place, and the United States must have a nuclear deterrent to meet these threats.

We must do so not only for ourselves, but for our non-nuclear weapons allies as well. Without our nuclear deterrent, and our ability to extend it to others, our allies could be subject to nuclear blackmail and might have to face the need to build their own deterrents. The US umbrella counters such threats and renders moot the question of allies having to consider creating their own nuclear capabilities. While the strictly deterrent aspect of this is usually understood, the diplomatic and non-proliferation benefits of the US extended nuclear deterrent are often overlooked—despite the fact that they are quite significant.

Is the nuclear deterrent an all-purpose deterrent? Of course not. No single weapons system or military capability has ever been capable of deterring the full range of threats facing the United States and our allies. Robust, advanced, and transformed conventional and counterterrorist forces are necessary and even now are assuming a larger role in our national security posture. Equally, however, such capabilities can never replace the unique roles played by our nuclear forces.

The New Triad (and the old one)

The Administration's 2002 Nuclear Posture Review (NPR), recognizing the changing shape of the international security environment, called for the creation of a new triad—of defenses, responsive infrastructure, and long-range strike—to ensure deterrence for the decades to come. The emphasis placed on one of the new legs, passive and active defenses, reflected the threat posed by the continued proliferation of ballistic missile technology. Similarly, the focus on a second of the new legs, a responsive nuclear infrastructure, was necessitated by the debilitating effect of years of inattention to and under-funding of the Department of Energy's nuclear weapons complex.

The third leg of the new triad—long-range nuclear and conventional strike forces—was built on the familiar old triad of nuclear forces which served us so well throughout the Cold War. In doing so, the NPR reaffirmed the value of an evolutionary concept which emerged from the roles and missions struggles of the immediate post World War II era. The fact that the old triad was not created deliberately—but rather was born as a result of inter-service rivalry—is today of only passing historical interest. What is important to remember is that once we had a triad bound together by a joint planning system, we recognized that the different attributes and characteristics of the ICBM force, the fleet ballistic missile submarine/submarine-launched ballistic missile (SSBN/SLBM) system, and the manned strategic bomber combined to produce a capability which far exceeded the simple sum of its parts. The strengths and characteristics of each of the three legs offset the vulnerabilities of the others and guaranteed that a Soviet technological breakthrough could not imperil the totality and, therefore, the certainty of a US response; the promptness of the ballistic systems was complemented by the bombers' ability to be recalled; and the enemy's inability to concentrate only on one form of American response contributed to an immensely difficult defensive problem. All of this underwrote deterrence. All of it continues to meet an ongoing national need. Put differently, elimination of one or more legs of the triad exposes us to all of the risks it has previously addressed so successfully: technological surprise, technical failure in a US system, and insufficient flexibility.

The Continued Role of the Intercontinental Ballistic Missile Force

The ICBM force's most unique attribute has been its basing scheme. Dispersed silos on sovereign United States territory put any potential aggressor on notice that his pre-emptive strike

would have to be massive and cover a wide swath of the American homeland—thereby provoking a major US response (and without any guarantee that the pre-emption would in fact be successful). More recently, the decision to modify the Minuteman III force so that a majority of its missiles will carry a single re-entry vehicle provides the United States with enormous flexibility which it previously lacked and which is uniquely suited to deterrence missions of the post-Cold War world: the ability to threaten to strike promptly and with great accuracy using only one warhead.

In addition, it is important that the Air Force continue to investigate the feasibility of using ICBMs to deliver conventional payloads. Prompt long range conventional strike has become a necessary element of US national power. Today, the United States has significant conventional strike capability in our air-breathing forces—but at the present time we can only engage against very long range targets after a repositioning of assets and an accompanying loss of time. Some targets will not linger until our air-breathing forces can be brought to bear, and, if those targets move while we are repositioning, our resulting inability to destroy them promptly at a great distance from our shores may result in these enemy assets being used against us, even inside the United States. As a result, it is essential that the Congress agree to fund the conventional variant of the D-5 SLBM. For the same reasons that impelled us to maintain a nuclear triad, however, the conventional D-5 should not be our only approach to this problem. A conventionally-armed ICBM may or may not be a feasible complement to the Navy system—but we will not be able to answer that question definitively if the required studies and analysis are not undertaken with a sense of urgency.

Intercontinental Ballistic Missiles in 2030

It is all well and good to assert that the ICBM force continues to fill a needed national mission but such statements of policy cannot ensure that the force will be available to carry out its identified mission. The Minuteman force has served the United States heroically for decades. It is beginning to get a little long in the tooth. If there is to be an ICBM force in the future, it will exist only if efforts to design and fund a major upgrade—or a follow-on—to the Minuteman system are undertaken promptly. Over time, the failure to do so will constitute a de facto decision to permit the Minuteman system to atrophy slowly without replacement. Despite the dedicated efforts of the officers and enlisted members of the force, it will inevitably waste away. A failure to sustain the force and to fund an upgrade or follow-on will also inevitably have a great impact on our most vital asset: the men and women of 20th Air Force. If ICBMs are seen as a dying career field, the Air Force's ability to retain the outstanding people the ICBM force now contains and to recruit the high-class talent needed to operate ICBMs in the future will decline. I believe, however, that the ICBM's value to the United States is recognized by the Air Force senior leadership and I expect that the right decisions will be forthcoming.

Franklin C. Miller (BA, Phi Beta Kappa, History and Political Science, Williams College; MPA, Woodrow Wilson School of Public and International Affairs, Princeton University) is a Vice President in The Cohen Group, a business strategy consulting firm based in Washington, DC and headed by former Secretary of Defense William S. Cohen. Mr. Miller joined The Cohen Group in March 2005 from the White House, where he had served since January 2001 as a Special Assistant to President George W. Bush and as Senior Director for Defense Policy and Arms Control on the National Security Council staff. His White House assignment capped a 31 year career in the US Government which included two years at the Department of State and twenty two years serving under seven Secretaries in a series of progressively senior positions in the Department of Defense. His final assignments in DoD were as Acting Assistant Secretary for International Security Policy from September 1996 to November 1997; Principal Deputy Assistant Secretary for Strategy and Threat Reduction from November 1997 to October 2000; and again as Acting Assistant Secretary from October 2000 until 20 January 2001. He was the senior career civilian official in DoD under Secretary Cohen. Mr. Miller was a guiding force in the development and implementation of all aspects of US nuclear deterrence policy for over 20 years. He also served as the chair of NATO's nuclear policy committee ("the High Level Group") from September 1996 to January 2001.

Mr. Miller currently serves on the US Strategic Command Advisory Group and is a Senior Associate in the Center for Strategic and International Studies' International Security Program. He is a member of the Council on Foreign Relations.

Mr. Miller served from 1972 to 1975 as a Surface Warfare Officer aboard the USS Joseph Hewes, a Knox-class frigate, with deployments in the Mediterranean, the Indian Ocean, and the Atlantic.

Mr. Miller has been awarded the Defense Department's highest civilian award, the Defense Distinguished Civilian Service Medal, five times, and received the Department's Distinguished Public Service Medal in lieu of a sixth award. His other US awards include the Department of State Distinguished Honor Medal, the Department of the Navy's Distinguished Public Service Medal, the Chairman of the Joint Chiefs of Staff Joint Distinguished Civilian Service Medal, the National Nuclear Security Administration Administrator's Gold Medal for Distinguished Service, and the Defense Intelligence Agency's Director's Medal. In addition, Mr. Miller has been awarded the Norwegian Royal Order of Merit (Grand Officer) and the French Legion of Honor (Officer).

The Future of Strategic Deterrence and the Intercontinental Ballistic Missile

Lt Gen Frank G. Klotz
Vice Commander, Air Force Space Command

The nature and exigencies of the Cold War gave rise to the concept of strategic deterrence and shaped American national security policy for nearly half-a-century.[1] During this era, the Nation's nuclear forces, including the intercontinental ballistic missile (ICBM), were the mainstay of the Nation's military force posture. Their designation as "Major Force Program 1" within the defense budget reflected this primacy. The United States invested enormous resources to ensuring that its strategic nuclear forces could withstand an attack aimed at them and retaliate against an aggressor, if directed to do so by the President. This commitment to maintaining a survivable and capable strategic nuclear force was essential to preventing a major conflagration between the two superpowers. It also helped set the conditions which ultimately allowed the United States and its allies to bring the full range of political, economic, and military power to bear in that titanic struggle, and ultimately to prevail.

With the collapse of the Soviet Union and the end of the Cold War in 1991, the international environment and security situation changed dramatically. The strategic nuclear threat to the United States substantially diminished while new, more varied threats to the Nation's security began to emerge and manifest themselves, most dramatically in the terrorist attacks of 11 September 2001 and the ensuing war on terrorism. As the global landscape changed, so too did America's defense posture. The US strategic deterrent force no longer occupied center stage, and its changing size and structure clearly reflected that fact. Through a series of unilateral actions and in compliance with arms control agreements, the United States has taken significant steps to reduce its nuclear forces, or to modify their alert levels. For example, the Air Force's nuclear-capable bombers no longer stand alert; all US land-based nuclear weapons have been withdrawn from Europe; nuclear weapons have been removed from naval surface vessels; the number of ballistic missile-carrying submarines has been reduced; and, US Strategic Command's "Looking Glass" airborne command post no longer routinely flies round-the-clock, seven-days-a-week as it did at the height of the Cold War.

America's ICBM force has likewise drawn down dramatically. To illustrate, 20 years ago 1,054 ICBMs were deployed at nine operational bases. Today, there are 500 missiles at three operational bases. To reach this lower level, the Air Force deactivated 54 Titan II missiles during the 1980s and 450 Minuteman II missiles during the 1990s. In September of last year, it completed deactivation of the 50 Peacekeeper ICBMs first deployed in Wyoming during the Reagan Administration. In keeping with the Moscow Treaty signed by the United States and Russia on 24 May 2002, the US has also removed hundreds of warheads from deployed Minuteman III ICBMs. At the end of the day, the Moscow Treaty will require the United States to reduce the number of operationally deployed strategic nuclear weapons from 6,000 to between 1,700 and 2,200 by 31 December 2012—or by nearly two-thirds—the lowest level in decades.[2]

President George W. Bush and Russian President Vladimir Putin sign an arms reduction treaty at the Kremlin in Moscow, Russia on 24 May 2002.

At the same time, the concept of strategic deterrence itself is essentially being recast. During the Cold War, strategic deterrence was largely predicated upon demonstrating both the capability and the will to respond to aggression upon the US, or its friends and allies, with overwhelming force so that any potential adversary would calculate that the risks and costs of launching an attack would far outweigh the gains. The so-called strategic nuclear triad—consisting of manned bombers, sea-launched ballistic missiles, and ICBMs—as well as theater nuclear weapons were the principal instruments for achieving this effect. The size and composition of this force was based in large measure on the size and capabilities of the principal military competitor—the Soviet Union. The requirement to deter other potential adversaries was for the most part treated as a lesser included case.

However, as stated in its recently-released Quadrennial Defense Review (QDR), the US Department of Defense is in now the process of shifting "from a 'one size fits all' notion of deterrence toward more tailorable approaches appropriate for advanced military competitors, regional WMD states, as well as non-state terrorist networks."[3] The future force required to provide for this evolving concept of strategic deterrence requires a wider-range of non-kinetic and conventional strike capabilities, integrated ballistic and cruise missile defenses, and a responsive infrastructure—a mix of capabilities commonly referred to as the "new triad." Significantly, the 2006 QDR also emphasizes that deterrence is achieved by persuading potential adversaries that their objectives in attacking would be denied and that any attack could result in an overwhelming response.[4]

While some observers outside government have argued that the United States has not done enough to adjust its nuclear posture to meet the new strategic realities of the post-Cold War era, the magnitude of force reductions taken (especially when viewed across the span of the 15 years since 1991) and the shift in both concept of and the means for achieving strategic deterrence are truly remarkable.

Despite the reduction in both the size and role of US nuclear forces within our overall defense posture, they nevertheless con-

tinue to play an important role. As Frank Miller points out in the previous article in this journal, the world remains a dangerous and uncertain place—a condition that is unlikely to change and perhaps will even worsen in the years ahead, particularly given the possibility that more nations (and even non-state actors) could develop or acquire weapons of mass destruction and the means to deliver them across intercontinental distances. For this reason, even as it stresses the need for "tailored deterrence," the QDR still calls for the maintenance of a "robust nuclear deterrent, which remains a keystone of US national power."

Sustaining and Modernizing the ICBM Force

In keeping with this and other national-level guidance, Air Force Space Command is engaged in a comprehensive program to ensure that the Minuteman III ICBM remains an effective, safe, and secure weapon system through the year 2020.

Virtually every inch of the missile—from the nose cone to the first stage nozzles—is being refurbished or modernized to extend its life, enhance its maintainability and security and, at the same time, reduce the cost of ownership. The solid rocket propellant in all three stages of the missile is being "re-poured"; components in the missile guidance system and the propulsion system rocket engine (or "post-boost" stage) are being replaced to extend service life; and, the missile launch control centers have been upgraded to take full advantage of recent advances in satellite and very low frequency communications. In the very near future, a number of the more up-to-date warheads removed from the deactivated Peacekeeper missile will be deployed on a portion of the Minuteman fleet; and, the missile alert and launch facilities will be equipped with more modern, commercially available heating, ventilation, and air conditioning components to enhance their supportability and reduce the maintenance workload. Finally, security at the remote missile launch facilities is being enhanced by reinforcing their concrete headworks and, beginning next year, by modifying the personal access hatch at these sites so that it can be "buttoned-up" faster when it has been opened up in order to perform maintenance. Plans are also in the works to supplement the security alarm system that currently protects all remote missile launch facilities with surveillance cameras.

To ensure that these actions do in fact maintain the Minuteman's effectiveness, Air Force Space Command will continue to conduct a comprehensive program to inspect missile and reentry system components for signs of aging, and to perform periodic operational tests—both in the missile field as well as unarmed test flights from Vandenberg Air Force Base, California. In 2006, four launches of the Minuteman were conducted—each one successful. Usually, the test flights are targeted toward the Reagan Test Site in the Kwajalein Atoll nearly 4,200 nautical miles down range. This year witnessed the missile's first extended range test when a Minuteman flew 5,100 nautical miles toward a target area in the ocean near Guam. At least three to four test launches are currently scheduled to take place every year for the foreseeable future.

As noted above, these measures are designed to sustain the Minuteman III force through the year 2020. At the same time, the Air Force is also defining requirements and analyzing possible alternatives for a next-generation ICBM system. As this process gets underway, it is worth bearing in mind two points. First, the current Minuteman system is the product of nearly four decades of evolutionary development involving successive generations of the booster itself (Minuteman I, II, and III), as well as the associated reentry and command and control systems. Second, components of the current Minuteman III missile system may well have significant residual capability left even after 2020. Predictions can and have been made about the potential service life of the motors and other hardware after undergoing the current upgrade programs; but, it's still too early to say with confidence just how long the Minuteman weapon system will be serviceable. Any strategy to maintaining an ICBM force beyond 2020 ought to account for the possibility that the Minuteman, like the venerable B-52, will far exceed lifespan expectations. Any outcome that avoids designing and developing a new ICBM "from scratch" has obvious appeal in terms of potential cost avoidance.

Even if the Minuteman continues to have operational utility past 2020, some additional block upgrades to the system may need to be made beyond those currently underway. For example, the existing guidance system uses outdated moving-mass gyroscopes and accelerometers that have reached their practical limits in terms of accuracy improvement and continue to require routine maintenance. Even with the improved performance of the upgraded missile guidance sets noted above, roughly one-third of the total number deployed in the missile field must be swapped out every year. Employment of more modern guidance technology could extend the mean time between failure by an order of magnitude, sharply reduce maintenance costs, and improve accuracy for future reentry systems and warheads. An upgraded guidance system would also incorporate modern maintenance practices that would significantly reduce the maintenance and security manpower required to repair missiles in the field. In a similar fashion, different and more technologically up-to-date approaches to command and control and to security monitoring could potentially further reduce manpower requirements and cost, while at the same time, enhancing the overall safety of the weapon system. Like all long-lived weapon systems essential to national defense, the Minuteman must continue to evolve and modernize to take advantage of current technologies and operational practices in order to free up resources (dollars and manpower) to support new capabilities and missions.

While extending the life of Minuteman III may ultimately prove to be a feasible and cost-effective approach to providing for an ICBM force not just through, but beyond 2020, prudence requires that we be alert to two possibilities. The first is the possibility that a breakthrough in missile defense technology could render purely ballistic approaches to delivering warheads obsolescent. This prospect argues for a strong research and development program in alternative reentry system technology. Second, the Air Force (as well as several private enterprises) is currently pursuing development of advanced booster concepts and technology for lower-cost and more operationally responsive access to space. It may be possible to, in effect, develop a "family" of boosters that could serve multiple missions, including the one currently performed by the Minuteman missile. If this proves to be the case, the costs of fielding a follow-on to the Minuteman

when it eventually does run out of service life could be significantly less than building a totally unique system.

One final point regarding the future of a long-range, land-based missile should be noted. Air Force Space Command is currently engaged in an Analysis of Alternatives of a Prompt Global Strike system. Such a system would provide the capability to precisely strike anywhere in the world within minutes with a conventional warhead—even in regions where the United States has no forward presence and regardless of the defensive threats posed along the way. As a near-term solution, the Navy is pursuing a conventionally-armed Trident Sea Launched Ballistic Missile capability. For the mid-term, the land-based missile offers an additional approach to providing a flexible, lethal, and affordable conventional strike capability. Air Force Space Command is currently exploring those mid-term options. Finally, the Analysis of Alternatives mentioned above will examine multiple basing approaches, delivery systems and warhead requirements and determine the most cost-effective approach to meet this critical mission need for the longer term.

A Final Thought

The size and composition of the ICBM force continues to evolve in response to the changing strategic environment. The 2006 QDR proposed a reduction in the number of deployed Minuteman III ICBMs from 500 to 450 beginning in fiscal year 2007.[5] This potential reduction does not, however, signal that strategic deterrence, or the ICBM force, is no longer relevant or important. As a Defense Science Board Task Force, chaired by former Air Force Chief of Staff, General Larry Welch, noted in 1998:

> "…the change in the relative value of the ICBM force is important and not adequately understood. This is the leg of the US Nuclear Triad of forces *whose value increases the most with declining forces*…" [6] (emphasis added)

In short, deterrence in this new era still requires the ICBM and its unique capabilities. Modernization and sustainment programs already underway give the continued assurance of a ready, capable force through 2020 and possibly beyond. More importantly, the women and men who operate, maintain, secure, and support the weapon system continue, as they have for over 40 years, to demonstrate the highest standards of technical expertise, professionalism, and devotion to duty. In the words of the current Air Force Chief of Staff, General Moseley, they are—and will remain—the ultimate "backstop" to the Nation's warfighters deployed both at home and overseas.

Notes:

[1] The Cold War spawned an extensive body of literature on the concept of nuclear deterrence. One of the best contemporary accounts of the entire field is Lawrence Freedman, *The Evolution of Nuclear Strategy*, 3rd ed. (2003).

[2] The text of the Moscow Treaty (also known as the Treaty on Strategic Offensive Reductions) and an accompanying factsheet can be found at the US Department of State website, http://www.state.gov/t/ac/trt/10527.htm (accessed 8 August 2006).

[3] US Department of Defense, *Quadrennial Defense Review Report*, 6 February 2006, 49, http://www.defenselink.mil/qdr/report/Report20060203.pdf (accessed 8 August 2006).

[4] Ibid., 25, 7.

[5] Ibid., 50. More recent commentary on post-Cold War deterrence concepts can be found in a number of articles by Keith Payne, including "Deterrence: A New Paradigm for a New Age," December 2003, http://www.nipp.org/Adobe/Regional%20Web/Deterrence%20Paradigm.pdf (accessed 8 August 2006).

[6] US Department of Defense, Defense Science Board, *Final Report of the Defense Science Board Task Force on Nuclear Deterrence*, July 1998, http://stinet.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA433328 (accessed 8 August 2006).

Lt Gen Frank G. Klotz (BS International Affairs, USAFA; MPhil, International Relations, Oxford University; PhD Politics, Oxford University) is Vice Commander, Air Force Space Command, Peterson Air Force Base, Colorado. He assists the Commander in the development, acquisition and operation of the Air Force's space and missile systems. The command oversees a global network of satellite command and control, communications, missile warning and launch facilities, and ensures the combat readiness of America's intercontinental ballistic missile force. The command comprises more than 39,700 space professionals who provide combat forces and capabilities to North American Aerospace Defense Command and US Strategic Command. General Klotz also directs and coordinates the activities of the headquarters staff.
He has commanded a Minuteman missile squadron, a missile launch task force, an operations group, a missile wing and a numbered air force. The general's staff assignments include tours on the Air Staff, in the Office of the Secretary of Defense and at the State Department as a White House Fellow. He has also served on the faculty of the Air Force Academy, at NATO headquarters in Brussels, at the American Embassy in Moscow, Russia, and as the Director for Nuclear Policy and Arms Control with the National Security Council at the White House.
General Klotz is a graduate of Squadron Officer School, National War College, and the Senior Officials in National Security Program at Syracuse University, New York.

Why America Needs ICBMs Contributing to Air and Space Power and Strategic Deterrence

Maj Gen Thomas F. Deppe
Commander, Twentieth Air Force

Nuclear weapons in general and intercontinental ballistic missiles (ICBMs) in particular stand as the Nation's ultimate insurance policy. They "provide the President with the means to terminate conflict promptly on terms favorable to the United States and cast a lengthy shadow over a rational adversary's decision calculus when considering coercion, aggression, weapons of mass destruction (WMD) employment, and escalatory courses of action."[1] Further, a "robust nuclear deterrent remains the keystone of US national power."[2] Since the end of the Cold War, many continue to question the relevancy of our Nation's nuclear weapons and the ICBM force. In fact, many of these people, both civilians and military, do not realize the United States still maintains ICBMs on alert. The following figures illustrate the level of effort put forward in the ICBM business. In 2005, ICBM professionals performed 40,150 person-days of alert duty, 54,600 person-days of missile maintenance, conducted 387 munitions convoys, flew 7,461 helicopter hours and drove 17,500,000 miles in support of this Nation's most responsive strategic deterrent.

There is also a belief that there are no longer catastrophic threats holding America at risk. While it is true that a massive nuclear exchange is unlikely, strategic threats exist today that demand vigilance. National guidance confirms this and places a premium on our nuclear capability. According to the *National Military Strategy of the United States of America, 2004*, "safe, credible, and reliable nuclear forces continue to play a critical role" and the National Military Strategy expands this premise by stating, Nuclear capabilities continue to play an important role in deterrence by providing military options to deter a range of threats, including the use of WMD/E and large-scale conventional forces. Additionally, the extension of a credible nuclear deterrent to allies has been an important nonproliferation tool that has removed incentives for allies to develop and deploy nuclear forces.[3]

In this article, I will discuss the 21st century security environment and the role of nuclear weapons. I will also address the subject of strategic deterrence and the role ICBMs play. Finally, I will highlight how Twentieth Air Force (20 AF) readiness, modernization programs, and personnel contribute to the Nation's deterrence capability.

Secure weapons transfer.

Today's Security Environment and the Role of Nuclear Weapons

Non-state actors and totalitarian regional states, many of whom demonstrate hostility to the United States and our interests, have replaced the US/Soviet contest during the Cold War. "Proliferation has given *small and medium states*, sub-national, ethnic, and religious groups, terrorists, and large crime cartels access to unprecedented destructive potential."[4] The potential for destructiveness from these non-traditional threats is less than that of the Cold War; however, the use of a nuclear device by an irrational actor becomes more likely. A major concern for our country's security is the growing threat from nations possessing WMD and a means to deliver them. Due to these threats, America's armed forces must continue to perform their nuclear deterrent missions, and the ICBM force provides this valuable service as the backstop of the Nation's strategic deterrence.

The total focus of this deterrence is no longer just against one superpower adversary. We now potentially face numerous aggressors who are less obvious than the former Soviet Union, and who are intent on hiding their capabilities. Moreover, we face a growing threat from at least two dozen states armed with WMD. To counter these threats, land-based ICBMs will continue to play an important role for the US by providing an alert-ready strike force today, and well into the future. The proliferation of missile technology and the spread of nuclear, chemical, and biological capabilities mean that our homeland, once thought to be safe behind two large oceans, is now threatened. Further, the effects of just one of these weapons could kill millions of Americans. We must leave no doubt in the mind

of potential enemies that using WMD against the US or its allies will not go unchallenged.

The final report of the "Commission to Assess the Ballistic Missile Threat to the US" offers three conclusions with regard to potential enemy threats and the need for the ICBM force: First, "concerted efforts by a number of overtly or potentially hostile nations to acquire ballistic missiles with biological or nuclear payloads pose a growing threat to the US, its deployed forces and its friends and allies."[5] Secondly, "the threat to the US posed by these emerging capabilities is broader, more mature and evolving more rapidly than has been reported in estimates and reports by the intelligence community."[6] Finally, the report concluded, "emerging powers therefore see ballistic missiles as highly effective deterrent weapons and as an effective means of coercing or intimidating adversaries, including the United States."[7]

Although this ballistic missile threat is real, ballistic missile systems are too expensive for many rogue actors to pursue. Our greatest concern comes from the irrational state and non-state actor willing to use less sophisticated means of delivery. During the Cold War, Soviet policy remained fairly rational and predictable. The Soviets understood that even if they started a war, they could not win. Russia and China represent rational people who live under a rule of government. Traditional deterrence works very well against these rational actors. On the other hand, our enemies today include individuals willing to commit suicide for their cause. Deterrence today requires more than nuclear weapons to be effective. Today, we need to challenge the bright thinkers in our military to solve the problem of tailoring our deterrence capabilities to meet diverse threats. Until then, the potential for an overwhelming US response must still be able to hold those who harbor the irrational actors accountable.

At present, US global strike capability consists of land based ICBMs, manned bombers, and submarine launched ballistic missiles (SLBM). While submarines and bombers provide survivability and flexibility respectively, ICBMs provide a prompt response unmatched by any other strategic system. To meet 21st century challenges, the ICBM force provides "stability through uncertain times" because of three enduring aspects.

Missile Maintenance Team performs system connectivity.

First, ICBMs provide the ability to "strike targets promptly and effectively to inflict any level of damage deemed appropriate by the President of the United States."[8] Second, ICBMs provide a "continuity of deterrence that bridges the gap between today and a new era."[9] Finally, ICBMs "provide a prompt day-to-day capability against WMD and hardened deeply buried targets (HDBTs)."[10] This capability, known to our friends and enemies alike, sets the conditions needed to deter would-be aggressors.

Strategic Deterrence

"Strategic deterrence is defined as the prevention of adversary aggression or coercion threatening vital interests of the United States and/or our national survival. Strategic deterrence convinces adversaries not to take grievous courses of action by means of decisive influence over their decision making."[11] Nowhere in that definition does the word "nuclear" appear. Nuclear weapons play only one part of this endeavor because strategic deterrence is designed to prevent war or escalation of a conflict through the use of all instruments of national power. Therefore, the end of the Cold War does not mean the end of strategic deterrence. The reality of facing an increasing number of adversaries armed with varying types of WMD makes deterrence even more important today. According to the *National Defense Strategy of the United States of America 2004*, "We will give top priority to dissuading, deterring, and defeating those who seek to harm the United States directly, especially extremist enemies with weapons of mass destruction."[12] As a result, if you are in the nuclear business, you are in the information operations business. Specifically, you are in the influence business. In order to influence, we must have a credible capability. For the ICBM community, that capability includes a near 100 percent alert rate that guarantees prompt response to aggression as well as the capability to threaten a wide range of targets world-wide with options that vary in scale, scope, and purpose. However, the ICBM mission remains about prudence, we are not looking for a fight. Rather, we provide a tool for the country in case of crisis much like the F-22. You never know what capability you will need in the future because "there is no guarantee that geopolitical circumstances will not change dramatically."[13]

The *Strategic Deterrence Joint Operating Concept* (SD JOC) describes three ways in which ICBMs can exercise influence over an adversary. The first is to credibly threaten to **deny an enemy the benefits** or gains sought by his actions.

> US nuclear capabilities can help convince an adversary that even the defeat of US or allied/coalition conventional forces can be rapidly and decisively reversed. Nuclear weapons assure allies that the US can (and will) deter, prevent, or limit damage to them from adversary attack, thereby bolstering allied political will, and making the benefits of adversary aggression or coercion less likely. The ability of nuclear weapons to deny an adversary sanctuary from attack helps convince him the benefits he seeks through aggression are unlikely to be achieved.[14]

A second way ICBMs exert influence is by credibly threatening to **impose costs** that are viewed as too painful to incur. ICBM forces provide the "ultimate means to impose costs upon an adversary. The nature of the costs nuclear weapons impose,

Security Forces protection exercise up-close.

and the speed and inevitability with which those costs can be imposed, is qualitatively different from even our most advanced conventional capabilities."[15] Weapon system improvements and innovations coupled with personnel training and readiness enhance ICBM credibility.

Finally, we can **induce adversary restraint** by influencing his perception of the potential consequences of his actions.

> In many cases where the adversary is convinced that the cost of aggression or coercion will be a US nuclear response, other considerations will tend to pale in comparison. The costs potentially imposed by credible US nuclear use can (in many scenarios) obviate consideration of such consequences of restraint.[16]

More specific ICBM contributions to influencing enemy decision-makers are made possible by three critical deterrent functions in 20 AF. These functions are force readiness, modernization programs, and highly trained personnel.

Readiness as Deterrence

"For deterrence to work, the threat of preemptive or retaliatory use must be credible" and weapon systems "must be maintained ready for use."[17] The nearly 10,000 men and women in 20 AF provide a credible deterrence today with a force of 500 Minuteman III missiles located in Colorado, Montana, Nebraska, North Dakota, and Wyoming. These weapon systems are maintained, secured and operated 24-hours-a-day, seven-days-a-week, 365-days-a-year by maintenance, security forces, and operations personnel. The personnel performing these duties are highly trained and their job performance is continually assessed. They undergo tough evaluations, recurring exercises, training and testing, and frequent inspections from higher headquarters to ensure maximum readiness. The missiles are fine-tuned periodically to maintain required accuracy, and they are tested regularly to ensure the highest reliability. All of this takes tremendous effort, resources, and dedication. However, it is precisely this effort that makes our ICBM force a formidable threat. Our adversaries understand our readiness, and they respect it. ICBMs provide national leadership several key advantages over other nuclear weapon systems. First, they provide an incredibly high day-to-day sortie alert rate, as well as the highest ratio of available weapons. Second, ICBMs are "rapidly retargetable and are the most responsive (minutes versus hours and days) system to target emerging threats (WMD and mobile systems) and can hold WMD production facilities at risk most anywhere in the world."[18] Third, "any attack on our ICBM force is a verifiable attack on the United States."[19] Attacks on submarines or bombers could be dismissed by an enemy as an accidental event. Finally, "ICBMs make it virtually impossible for an enemy to wipe out our entire nuclear force with a single surprise attack. Our bomber and submarine forces are minimally dispersed into just five main operating bases."[20] When considering the 500 dispersed silos and their respective launch control centers, the Minuteman III presents an adversary with an extremely large number of aim-points to disable our nuclear capability. As a result, such a vast target set reduces the adversary's payoff for attacking during a crisis.[21] The Welch Report confirmed this when it concluded: "Significant numbers of ICBMs deny any adversary the benefit of a limited attack. Without the ICBMs, surprise attacks against a handful of bomber bases and SSBN facilities, with plausible deniability, could drastically alter the correlation of forces."[22] Simply put, if you do away with ICBMs, the targeting problem for an adversary is greatly simplified because their target set dwindles from over 500 targets to about a dozen (nuclear capable bomber bases, Trident main operating bases and nuclear command and control facilities). Such a small target set may only invite aggression—it certainly does not dissuade the aggressor.

The above discussion offered the reasons for, and the continued need of an alert-ready ICBM force. Our Minuteman III ICBM is a remarkable weapon system that is reliable, available, secure, and affordable. However, like many systems in our Air Force, the Minuteman III is aging and we are working very hard to modernize our capability today. These modernization programs are an extremely valuable contribution to maintaining influence over potential enemies.

Modernization as Deterrence

The planned, or in-work, ICBM modernization programs will extend the life of the weapon system until at least 2020. These programs include the guidance replacement program, propulsion replacement program, propulsion system rocket engine life extension, rapid execution and combat targeting service life extension program, environmental control system program, safety enhanced reentry vehicle program, and extensive security enhancements.

- The guidance replacement program will replace portions of the missile guidance system to increase the reliability and maintainability of the weapon system.
- The propulsion replacement program involves replacing the propellant of the first three stages and some of the hardware components.
- The Propulsion System Rocket Engine life extension program will replace components of the post-boost vehicle and modernize support equipment.
- The rapid execution and combat targeting (REACT) service life extension program is a modification of the computer operating program for the command and control system.

- The environmental control system service life extension program will replace air conditioning components and control systems and upgrade the remote monitoring capabilities.
- The safety enhanced reentry vehicle program will replace some of the older Minuteman reentry vehicles with the newer, safer, and more reliable warheads from the recently retired Peacekeeper weapon system.
- The ICBM Security Modernization program is designed to increase the security characteristics of our launch facilities.

Collectively, these programs provide a more capable weapon system to United States Strategic Command (USSTRATCOM) strike planners. Furthermore, this enhanced capability provides a credible weapon system to perform strategic attack missions world-wide. However, the best weapon system in the world is only as good as the personnel assigned to employ it. The most important component of the 20 AF deterrence portfolio is our highly skilled operators, security forces and maintainers.

Personnel as Deterrence

It is absolutely essential for all personnel in the ICBM business to be familiar with the interconnects between different air force specialty codes (AFSCs) in 20 AF. Operators are not alone in the field. Maintainers and security forces work there as well, and they all need to understand what the other is doing. In this sense, we are all missileers and operating the Minuteman III is our business. In 2005, General Lance W. Lord, then Commander of AFSPC, provided what I consider one of the best and most succinct descriptions of the value of ICBM personnel to AFSPC and the USAF when he said:

> … there is no better skill to have as a Space Professional than a complete and comprehensive appreciation for nuclear operations. It teaches us all the meaning of "bombs on target." It gives us our "Warrior Ethos" and it has been pivotal in transforming our command from a research and development background to an operational Major Command in our great Air Force.[23]

As a result of this way of thinking, I believe a missileer's education in the ICBM community (Warfighting 101) is extremely valuable to AFSPC and the USAF. Moreover, if done correctly, we can educate an overwhelming majority of our 13S personnel in operations, strike planning, and weapons employment. Traditionally, we have lauded the operations skill set that the ICBM community brought to the rest of the command. To move forward, we need to focus on providing ICBM planning and tactics skill sets to the command as well. The latest versions of *ICBM Emergency War Order (EWO) Operations and ICBM EWO Training and Evaluation Procedures* spell out the requirement for 20 AF to create a Strike Planning Job Performance Requirement (JPR) as well as an EWO Course to develop nuclear expertise as well as strike planning knowledge. As a source document for these efforts, personnel from USSTRATCOM, AFSPC, and 20 AF are writing the first-ever ICBM Tactics, Techniques, and Procedures (TTP) volume. This volume will serve to start a cascading effect that will change the way space weapons officers are taught at the weapons school and the way all space professionals are educated in Space 100-300. This education process will not only produce officers with better skill sets for the nuclear business, it will produce officers ready to apply operations, planning and tactics skill sets to the next space weapon system.

Payload Transporter leaves the launch facility.

Operations crew.

Warfighting 101

The first day for an ICBM student at Vandenberg is not only his or her first day of initial qualification training; it is also the first day of a graduate-level education in warfighting. This curriculum, what I call "Warfighting 101," must include weapon system operations, strike planning and tactics. This education will not only create nuclear weapon system experts, but personnel who have the ability to relate to the bigger Air Force and who have the skills required to take other space disciplines to the next level of warfighting capability. Whether it is launch procedures, sortie generation or securing Priority A resources, missileers must have the basic knowledge to relate ICBM skill sets to the entire MAJCOM and the Air Force as a whole.

Operations

The ICBM community provides the majority of expertise in the area of weapon system operations. Specifically, the ICBM community provides AFSPC with personnel skilled in standardized crew procedures and crew coordination (value of

crew interchangeability); knowing the importance of operating instructions, technical orders, checklists (to include checklist discipline); the value of standardized training/evaluation (documented performance standards); and, most importantly, an understanding of weapon system safety rules, security and weapon system survivability.

Weapon System Development

In addition to propagating proven operations skills, we need to share our extensive understanding of weapon system development. ICBM personnel hold a unique position in that they know what makes a weapon system and should be able to help educate the rest of the command. A weapon system's traits include: standard procedures, technical data and testing/analysis to include measures of merit such as consequence of execution, probability of kill, damage expectancy, probability of arrival, and so forth. We must expand our officers' knowledge of how to build a weapon system within the joint requirements process. We must ensure that our officers build systems with utility to combatant commander's requirements and not for the sake of building an amazing piece of technology. Finally, our officers must understand that the fanciest weapon system is only as good as the doctrine, procedures, TTPs, and approved operations orders that govern its use.

Strike Planning

A vast potential exists for missileers to facilitate stronger air/space integration through an increased knowledge of planning. ICBM personnel have the ability to provide the majority of strike planning expertise to AFSPC. This expertise will not only enhance the knowledge for ICBM operations but will be especially relevant to the emerging Space Superiority mission. However, very few ICBM personnel are getting the exposure to planning processes until they are an O-4 working at USSTRATCOM or as a weapon school graduate working in a combined air operations center. It should be the intent of 20 AF and AFSPC to create expert nuclear strike planners with a solid understanding of Air Force/Joint planning processes. There are many benefits to increasing missile officer strike planning knowledge. The benefits for 20 AF include delivering weapons school knowledge to the masses. Officers with extensive weapons/tactics and planning knowledge will be key to combat crew proficiency fleet-wide. Furthermore, maintainers and security forces who understand the intent of the weapon system will be able to better support and offer guidance in this endeavor. Benefits to AFSPC and USSTRATCOM include the supply of planning experts to other space systems, creating a knowledgeable pool for USSTRATCOM duty, and training future Joint Space Operations Center (JSpOC) planners. Finally, a benefit to the USAF comes in the air/space integration arena by providing space personnel who can talk planning AF-wide with the ability to contribute in conventional planning shops and in other joint billets. We can achieve these goals relatively quickly but first, we must acknowledge these opportunities and advocate for their increased development.

The Way Ahead

As an ICBM community (operations, security forces, maintenance), we must actively educate the command on what we provide them—personnel skilled in maintaining, securing, and operating AFSPC's oldest weapon system. This is not to advocate a "we know it all" approach. Rather, it suggests that more educated discussions should occur about proven operations practices from a mission area that has flourished for over 40 years. The job of the missile community is to effectively communicate what ICBMs provide to the command and the Nation. We must be space educated (Space 100-300), operations focused, knowledgeable of weapon system development, and skilled in strike planning and tactics employment. ICBM personnel should not withdraw from the command into some kind of missile cocoon and downplay their ICBM experience. The rest of the Air Force and AFSPC will pass us by. By stressing our differences in a way that alienates the rest of the command, the positive aspects of the ICBM business will be lost. Let me be clear, this is not an ICBM mission versus Space mission proposition (that happened in the early 90s). The reality is more 13S officers (70 percent) come through 20 AF in their first four years than through 14 AF. The command must not allow those officers to spend their first four years simply marking time until they go do their "real" space job. We cannot allow this sort of thinking to continue. There are too many officers who performed ICBM duty who discount that experience as being irrelevant. Not only is the Air Force getting short on nuclear expertise but space professionals skilled in the areas previously discussed are absolutely essential to air/space integration. The days of the "pure space" officer are over—more personnel in the command have done both space and missile duty and need both experiences to improve the command. 20 AF stands ready to provide this experience based on our sortie generation, security, and planning expertise.

The next generation ICBM must provide "quick response, positive control, decisive firepower, and precision accuracy" in order to provide a variety of options to the President with the qualities needed to respond during any phase of conflict.

So, what is the future of the ICBM? The 2001 Nuclear Posture Review provides for the US to maintain a sufficient number of nuclear weapons to prevent an enemy from achieving parity.[24] The Nation's new triad of strategic forces will consist of nonnuclear and nuclear strike forces, active and passive defenses, as well as infrastructure to build and maintain the force.[25] Under this new construct, ICBMs provide a logical starting point for designing tomorrow's strategic deterrent force.

The next generation ICBM must provide "quick response, positive control, decisive firepower, and precision accuracy"

in order to provide a variety of options to the President with the qualities needed to respond during any phase of conflict.[26] "Many of these capabilities already exist in our current Minuteman III ICBM but the future system must also take advantage of emerging technologies."[27] AFSPC is already analyzing the alternatives for a follow-on nuclear deterrent to the Minuteman III. Another consideration for the next follow-on ICBM system is the option of arming a portion of the ICBM force with conventional warheads for enhanced prompt global strike capabilities that could be used in all levels of conflict in any theater.

USSTRATCOM's global strike mission requires the capability to strike world-wide and with precision against specific, time-sensitive targets. Conventional ICBMs may provide a niche capability to meet combatant command requirements. Unlike aircraft that take time to generate and may be hours from a target or unable to penetrate enemy airspace, or submarines, which could be days from their assigned launch boxes, an ICBM can be ready to strike globally within minutes. "What we need is a cost-effective system with a process for assuring non-adversaries of non-nuclear payloads and we must also ensure safe areas for disposing of the missile's boosters."[28] This conventional capability would ensure ICBMs remain a key element of military and political strategies and a vital part of USSTRATCOM's global strike tool kit.

Conclusion

Douglas J. Feith noted that "The Cold War system of two competing blocs has been replaced by a new system, one with a broad spectrum of potential opponents and threatening contingencies."[29] As the only on-alert, rapidly-executable nuclear capability, the dispersed ICBM force provides both a stabilizing element and the ability to dissuade a potential adversary from attempting a "sprint to parity" or a disarming first strike. Additionally, there are other scenarios than an attack on the homeland that provide utility to the ICBM force. "The United States requires a broad set of options to discourage aggression and coercion."[30] Major General Tim McMahon, retired, former 20 AF/CC, describes the following scenario,

> If the US is involved in a struggle where WMD is being deployed, and we're taking 5,000-10,000 casualties per day—or far more if WMD is being used—the question will be: How long do you want this to go on? The ICBM has an inherent capability to go far and go urgently.[31]

Will this scenario ever happen? Would an ICBM really be used? No one can predict the future or what the US response might be. As military professionals, we should not be in the business of self-deterrence. By that I mean that our job in the US military is to provide a variety of viable options to the President of the United States. The National Defense Strategy directs this by stating that "this strategy is intended to provide the President a broad range of options. These include preventive actions to deny an opponent strategic initiative or preempt a devastating attack."[32]

"America's ICBM force has a critical role in our national security and defense strategies."[33] In today's world, we must be able to deter attack while providing a range of responses

Missile emplacement.

through a diverse and robust group of nuclear and non-nuclear delivery systems. USSTRATCOM is championing "the need for a prompt, precise conventional global strike capability, to bridge the gap between prompt nuclear weapons and less timely, but precise, conventional weapons."[34] The conventional ICBM speed of response and ability to attack anywhere, any time, will provide national leaders the flexibility to deter and, if required, defeat adversaries. Modernization and sustainment programs already under way ensure a capable force through 2020. Beyond 2020, an ICBM-like system will provide the ever-ready portion of our deterrent strength. Moreover, any nuclear or non-nuclear global strike capability should provide the same traits of today's ICBM force.

In 20 AF, our primary focus is to prepare our people for the strategic deterrence challenges of this century. Creating technology for its own sake is not what military space professionals should be aspiring to accomplish. We should be developing the capabilities needed by the Nation to provide options to cover the full spectrum of conflict. With those challenges in mind, what should our 20 AF space professionals be thinking about? The following questions provide a place to begin the dialogue:

- How can I relate ICBM processes/procedures to my next (or a future) weapon system?
- What will replace the ICBM?
- What new weapon will give us an immediate day-to-day option for global strike?
- What are the weapons measures of merit?
- How will we ensure weapon system survivability?
- How will it be secured?
- How would I employ this technology/new way of war as a weapon?
- How can we hold mobile missile systems at risk?
- What is the space answer to the HDBT problem?
- How will space assets counter WMD facilities?

20 AF needs talented, hardworking, committed professionals as combat crew members, missile maintainers, and security force members to work these tough challenges. These personnel will take the valuable education provided in 20 AF and apply it to 21st century challenges throughout AFSPC and the USAF.

Notes:

[1] Department of Defense (DoD), *Strategic Deterrence Joint Operating Concept (SD JOC)* (Offutt AFB, NE: USSTRATCOM, February 2004), 32.

[2] Department of Defense, *Quadrennial Defense Review (QDR)* (Washington DC: Department of Defense, February 2006), 49.

[3] Joint Chiefs of Staff (JCS), *National Military Strategy of the United States of America 2004* (Washington DC: Chairman of the Joint Chiefs of Staff, 2004), 11.

[4] National Institute for Public Policy (NIPP), *Strategic Offensive Forces and the Nuclear Posture Review's 'New Triad,'* March 2003, 7.

[5] Commission to Assess the Ballistic Missile Threat to the United States (Rumsfeld Commission), "Final Report," 15 July 1998, section II-A.

[6] Ibid., section II-A.

[7] Ibid., section II-C-1.

[8] NIPP. *Strategic Offensive Forces*, 20.

[9] Ibid., 20.

[10] Ibid., 20.

[11] DoD, SD JOC, 4.

[12] Department of Defense, *National Defense Strategy of the United States of America 2004 (NDS)* (Washington DC: Department of Defense, March 2005), 6.

[13] John Deutch, "A Nuclear Posture for Today." *Foreign Affairs*, January/February 2005, 51.

[14] DoD, SD JOC, 34.

[15] Ibid., 34.

[16] Ibid., 34.

[17] Deutch, "A Nuclear Posture for Today," 50.

[18] Air Force Space Command (AFSPC), "AFSPC ICBM Force Structure," briefing slides, 18 April 2001, slide 15, notes page.

[19] Ibid., slide 15.

[20] Frank G. Klotz, "National Defense University Speech," 23 June 2004.

[21] Air Force Space Command (AFSPC), "The Case for 500 Minuteman IIIs for START III," briefing, 25 September 2000, slide 9.

[22] Defense Science Board, "Report of the Task Force on Nuclear Deterrence (Welch Report)," October 1998, 14.

[23] Lance W. Lord, "Strategic Deterrence: Evolving Our Mindset and Capabilities," speech, 20 April 2005.

[24] JD Crouch, "Special briefing on the Nuclear Posture Review (NPR)," Pentagon briefing, 9 January 2002.

[25] JCS, *National Military Strategy*, 11.

[26] Richard A. Paulsen, *The Role of US Nuclear Weapons in the Post-Cold War Era* (Maxwell AFB, AL: Air University Press, 1994), 159.

[27] Klotz, "National Defense University Speech."

[28] Ibid.

[29] Statement of the Honorable Douglas J. Feith in "Senate Armed Services Hearing on the Nuclear Posture Review," congressional testimony, 14 February 2002.

[30] JCS, *National Military Strategy*, 11.

[31] William B. Scott, "Rapid Response," *Aviation Week and Space Technology*, 6 April 2003.

[32] DoD, *National Defense Strategy*, 8.

[33] United States Senate to Secretary of Defense Donald Rumsfeld, letter, 10 May 2006.

[34] James E. Cartwright, Statement before the Strategic Forces Subcommittee of the Senate Armed Services Committee, congressional testimony, 29 March 2006, 12.

Maj Gen Thomas F. Deppe (BA, Management, Tarkio College, St Louis, Missouri; MS, Systems Management, University of Southern California) is Commander, 20th Air Force, Air Force Space Command, and Commander, Task Force 214, US Strategic Command, Francis E. Warren Air Force Base, Wyoming. He is responsible for the Nation's Intercontinental Ballistic Missile force, organized into three operational space wings with more than 9,600 people.

The general was commissioned in 1977 through Officer Training School. He has held various wing and headquarters-level positions in intercontinental ballistic missile, space and maintenance operations.

General Deppe has commanded a ground launched cruise missile flight in NATO and a Minuteman II maintenance squadron in Air Combat Command. He also commanded a Minuteman III missile wing, an ICBM logistics group and was vice commander of a space launch wing in Air Force Space Command. He has also served as Deputy Director for Operations at the National Military Command Center. Most recently he served as Director, Logistics, and Communications, Chief Information Officer and Chief Sustainment Officer, Headquarters Air Force Space Command, Peterson Air Force Base, Colorado. He is a master missileer in both operations and maintenance.

General Deppe is also a graduate of Squadron Officer School, Armed Forces Staff College, and Air War College.

Strategic Deterrence, Tailored Deterrence, and Implications for the Intercontinental Ballistic Missile Force

Ms. Amy F. Woolf
National Defense Specialist, Foreign Affairs, Defense, and Trade Division, Congressional Research Service

Introduction

If anything is close to certain in today's security environment, it is the assertion that almost everything has changed since the demise of the Soviet Union in 1991 and the terrorist attacks in 2001. The United States now faces an international security environment "characterized by uncertainty and surprise."[1] According to the 2006 Quadrennial Defense Review (QDR), the Department of Defense (DoD) will shift its emphasis to meet the new strategic environment." One example of this is the shift "from 'one size fits all' deterrence to tailored deterrence for rogue powers, terrorist networks, and near-term competitors."[2] *Tailored deterrence* is used to explain, and justify, many of the changes in force structure, planning, and operations associated with 2001 Nuclear Posture Review. Further, the distinction between "one size fits all" deterrence and tailored deterrence is designed to evoke an understanding of just how much things have changed in US nuclear strategy since the end of the Cold War and the 9/11 attacks. But the reality of US nuclear policy may not match the rhetoric used to describe this new approach.

This article will review US nuclear policy during and immediately after the Cold War to demonstrate that the United States has always tailored its targeting doctrine, employment policy, and force structure to maintain the credibility of its nuclear deterrent. It will then demonstrate that *tailored deterrence* differs from the Cold War construct of *strategic deterrence* by expanding the scope of US policy to deter potential conflicts with a greater number of nations and a wider range of threats. The article will conclude with a review of the implications of these changes in US nuclear strategy for the US intercontinental ballistic missile (ICBM) force.

Background

Strategic deterrence refers to a concept, grounded in game theory, that describes an ongoing interaction between two parties. In spite of the common shorthand of the Cold War era, *deterrence* and the *threat of nuclear destruction* are not interchangeable concepts. In a deterrent relationship, one or both parties seeks to convince the other to refrain from specified actions by convincing the other that the costs of acting will far outweigh the benefits. This can be done by threatening to impose high costs, threatening to deny the benefits sought by the other nation, and promising to withhold the costs if the nation forgoes the specified action.

As Thomas C. Schelling noted in his classic exposition, *The Strategy of Conflict,* "the threat has to be credible to be efficacious..."[3] Questions about the credibility of the US nuclear deterrent persisted throughout the Cold War, and the United States adjusted its doctrine, targeting strategy, and force structure periodically to bolster its credibility and enhance deterrence. The concept of *tailored deterrence* seems to follow the same logic. The Bush administration has argued that the United States must adjust its doctrine, targeting strategy, and force structure to deter a wider range of threats from a greater number of adversaries. In essence then, the United States is not seeking to "tailor deterrence," but, rather, to tailor its weapons capabilities, operational plans, and targeting strategies to enhance the credibility of its deterrent posture.

Strategic deterrence presumes an ongoing process of communication between the parties. The communication may be indirect or even ambiguous, but it is presumed that both parties know the stakes and risks associated with their possible actions. Tailored deterrence focuses less on maintaining a deterrent relationship with another nation than it does on acquiring the capabilities to attack and destroy valued targets in another nation. While, as is noted below, this capability may be necessary for a deterrent threat to be credible, it is not sufficient to establish or presume the broader conditions of *strategic deterrence*. It is, in essence, deterrence at the operational level, rather than the strategic level.

Deterrence During the Cold War

During the Cold War, the United States sought to maintain "nuclear and conventional capabilities sufficient to convince any potential aggressor that the costs of aggression would exceed any potential gains that he might achieve."[4] The Soviet Union was the only nation that could pose a global challenge to US allies and interests and threaten the political survival of the United States. Other nations, such as those in Soviet-dominated Eastern Europe, were included in the US nuclear war plans, but their presence reflected their relationship with the Soviet Union more than any independent threat they might pose to the United States or its allies. China could also threaten US interests, and the United States maintained the capability to respond to possible contingencies in Asia. However, the Soviet threat dominated US defense planning; nuclear forces sized to deter the Soviet threat were thought to be sufficient to deter or respond to these "lesser included cases," even though the nature of the response would differ.

Throughout the Cold War, the United States sought to make the threat of nuclear retaliation credible by adjusting its forces

and targeting strategy. During the 1950s, the doctrine of "massive retaliation" envisioned a "simultaneous, massive, integrated" US nuclear strike against targets in the Soviet Union, Eastern Europe, and China if the Soviet Union or its allies initiated any nuclear or conventional attack against the United States or its allies.[5] But many questioned whether the Soviet Union would believe that the United States would launch a massive nuclear attack in response to any level of Soviet aggression against Western Europe, particularly since the Soviet Union was developing nuclear capabilities that might allow it to retaliate against US cities *after* the United States launched its strike. Secretary of Defense Robert S. McNamara responded to these concerns, in the early 1960s, with "damage limitation," which called for attacks against Soviet conventional and nuclear military forces. The United States would seek to impede the Soviet Union's warfighting capability, in general, and its ability to attack US cities, in particular.[6]

In the mid-1960s, Secretary McNamara outlined the doctrine of "assured destruction,"[7] which was designed to convince the Soviet leadership that Soviet society would be destroyed if it attacked the United States or its allies. However, many again questioned the credibility of a doctrine that called for massive strikes against Soviet society. Therefore, the United States shifted its doctrine again, to "Flexible Response" in the 1960s and "Countervailing Strategy," in the late 1970s. These policies emphasized retaliatory strikes on Soviet military forces and war-making capabilities, as opposed to attacks on civilian and industrial targets, and called for limited, focused attacks on specified military targets, instead of large-scale attacks on a greater number of sites. These attack options were contained in the highly classified Single Integrated Operational Plan (SIOP). According to scholarly reports, the SIOP evolved through the years, in response to changes in US nuclear capabilities and US nuclear doctrine. Throughout, though, the attack options varied in terms of the numbers and types of targets to be attacked and the numbers and types of US warheads available when the conflict began.[8] The SIOP provided the President with options, it did not present a "one size fits all" choice.

In 1990, General John T. Chain, Jr., Commander in Chief of the Strategic Air Command, summarized the choices available to the President by noting that "the task is to … have a postured retaliatory force significant enough to destroy what the attacker holds most dear … Against this macro mission, target categories are designated. Within these target categories, a finite list of targets are designated; and against those targets, weapons are allocated."[9] These target categories reportedly included Soviet strategic nuclear forces, other military forces, military and political leadership, and industrial facilities.[10]

The United States sought the capability to destroy thousands of targets in the Soviet Union, even if many US weapons were destroyed by a Soviet first strike. This created the requirement for large numbers of US strategic nuclear weapons. By the end of the 1980s, the United States deployed nearly 12,000 warheads on its land-based missiles (ICBMs), submarine-launched ballistic missiles (SLBMs) and heavy bombers. In defending this "triad" of delivery vehicles, analysts argued that the different basing modes would enhance deterrence and discourage a Soviet first strike because they complicated Soviet attack planning and ensured the survivability of a significant portion of the US force in the event of a Soviet first strike.[11] The different characteristics of each weapon system might also strengthen the credibility of US targeting strategy. For example, ICBMs had the accuracy and prompt responsiveness needed to attack hardened targets such as Soviet command posts and ICBM silos. SLBMs had the survivability needed to complicate Soviet efforts to launch a disarming first strike and to retaliate if such an attack were attempted. Heavy bombers could be dispersed quickly and launched to enhance their survivability, and could be recalled to their bases if a crisis did not escalate into conflict. It was the sum of this force, as much as the details of the specific targets that could be destroyed in an attack option, that provided the United States with a robust *strategic deterrent*.

Deterrence After the Cold War

The Clinton administration argued that nuclear weapons remained important to deter the range of threats faced by the United States in the 1990s. Nevertheless, the Clinton administration recognized that "the dissolution of the Soviet empire had radically transformed the security environment facing the United States and our allies."[12] Russia could still, potentially pose a threat to the United States, but the United States also faced growing threats from a number of emerging adversaries. Many of these potential adversaries were pursuing "efforts to obtain or retain nuclear, biological, or chemical weapons, and, in some cases, long-range delivery systems."[13]

The United States did not directly threaten to use nuclear weapons in retaliation for non-nuclear attacks from these nations. The Clinton administration's policy, consistent with the long-standing US approach, was one of "studied ambiguity," neither ruling in nor ruling out the possible use of nuclear weapons in any given circumstance. At the same time, though, it indicated that the United States reserved the right to use nuclear weapons first "if a state is not a state in good standing under the Nuclear-Nonproliferation Treaty or an equivalent international convention,"[14] or if it attacked the United States or US forces with weapons of mass destruction (WMD).[15]

After the disintegration of the Warsaw Pact and collapse of the Soviet Union, DoD conducted several studies to review US nuclear targeting strategy and weapons employment policy. According to published reports, these reviews revised and greatly reduced the length of the target list, but left the basic tenets of the strategy untouched. According to a 1995 article in the Washington Post, "the United States primary nuclear war plan still targets Russia and provides the President an option for counterattack within 30 minutes of confirmed enemy launch."[16] Even after the Clinton administration altered the US strategy from seeking to win a *protracted* nuclear war, a strategy identified during the Reagan administration, to seeking to deter nuclear war, the United States did not alter the core objectives of its nuclear policy. It reportedly continued to prepare a range of attack options, from limited attacks involving small numbers of weapons to major attacks involving thousands of warheads, and

to plan attacks against military targets, nuclear forces, and civilian leadership sites in Russia.[17] The President would have still a range of attack options to choose from and was not limited to a "one size fits all" deterrent posture.

The United States did reduce the size of its nuclear arsenal during the 1990s. The 1991 Strategic Arms Reduction Treaty mandated that the United States and Russia each reduce their strategic offensive nuclear forces to 6,000 accountable warheads. Nevertheless, the United States continued to maintain a triad of strategic nuclear forces with warheads deployed on land-based ICBMs, submarine-launched SLBMs, and heavy bombers. According to DoD, this mix of forces not only offered the United States a range of capabilities and flexibility in nuclear planning that complicated an adversary's attack planning, but also hedged against unexpected problems in any single delivery system.

Deterrence in the 21st Century

The Bush administration has emphasized that nuclear weapons "continue to be essential to our security, and that of our friends and allies."[18] They are the only weapons in the US arsenal that can hold at risk the full range of targets valued by an adversary. As a result, "they provide credible capabilities to deter a wide range of threats, including weapons of mass destruction and large-scale conventional military force."[19] According to the 2006 QDR, "the aim is to possess sufficient capability to convince any potential adversary that it cannot prevail in a conflict and that engaging in a conflict entails substantial strategic risks beyond military defeat."[20]

The Bush administration has indicated, however, that *strategic deterrence*, modeled on the Cold War strategy, would not be sufficient to meet the requirements of deterrence in the new security environment. The United States plans to alter its doctrine, force structure, targeting strategy, and attack plans to address the threats posed by potential adversaries in the future. This is the essence of *tailored deterrence*. According to Ryan Henry, the Principal Deputy Secretary of Defense for Policy, the United States is "still looking at deterrence as a way to keep adversaries from acting by denying them benefits or imposing great costs." But it must develop three types of capabilities to do this in the future. It must have "the means to determine what assets an adversary holds dear and wants to protect; an ability to identify which military tools can be used to threaten those assets; and an effective means of communicating to adversaries that the military can target their most important assets and destroy them."[21]

The United States pursued the same range of capabilities during the Cold War, seeking to identify the range of valued targets in the Soviet Union, identifying the numbers and types of nuclear weapons needed to threaten these targets, and communicating with the Soviet Union that these targets were at risk and would be destroyed if the Soviet Union attacked the Untied States or its allies. The key difference in the current security environment is the fact that, as the Bush administration has often stated, Russia and the United States are no longer enemies and, when planning its nuclear policy and force structure, the United States now faces threats from "multiple potential opponents, sources of conflict, and unprecedented challenges."[22]

DoD has changed the US strategy for targeting nuclear weapons from threat-based targeting to capabilities-based targeting. Instead of focusing on the forces and attack plans needed to defeat the "Soviet threat" when planning for the possible use of nuclear weapons, the United States would "look more at a broad range of capabilities and contingencies that the United States may confront" and tailor US military capabilities to address this wide spectrum of possible contingencies.[23]

The administration has highlighted the threat posed by hardened and deeply buried targets, and has focused on the US need to develop the capabilities to defeat these targets. Analysts have also suggested that the United States improve its capabilities against mobile or fleeting targets, perhaps by enhancing its ability to attack promptly, or perhaps preemptively, at the start of a conflict. Further, a 2002 study sponsored by the Defense Threat Reduction Agency (DTRA) identified four broad target categories that the United States would want to hold at risk as a part of its deterrent strategy. These included WMD forces, conventional military capabilities, war supporting infrastructure, and leadership facilities. This study noted that "capabilities-based planning is designed to create requirements for a diverse, well-hedged, highly responsive and adaptable force."[24]

These are the same types of targets that the United States sought to threaten in the Soviet Union. Soviet missile silos and command centers were hardened and deeply buried targets, and the United States improved the accuracy of its weapons and their ability to penetrate upon attack in an effort to threaten these targets. When the Soviet Union began to deploy its ICBMs on mobile launchers in the 1980s, the United States sought the capability to track and destroy these systems. Moreover, the target categories listed in the DTRA study are the same categories, with WMD forces replacing nuclear forces, that the United States focused on in the Soviet Union. The key difference now is that the United States is seeking to develop the capability to threaten these types of targets in a greater number of nations.

At the conclusion of the Nuclear Posture Review, the Bush administration announced that the United States would reduce its strategic nuclear forces to 1,700-2,200 "operationally deployed warheads" during the next decade. It codified these reductions in the 2002 Strategic Offensive Reductions Treaty (known as the Moscow Treaty) with Russia. The United States has already eliminated 50 Peacekeeper ICBMs, which carried 500 warheads, and converted four Trident submarines, which counted as carrying 576 warheads, to non-nuclear missions. The QDR also proposed that the Air Force eliminate 50 of its 500 Minuteman III ICBMs and reduce the size of the B-52 fleet to 56 aircraft, and that the Navy convert two Trident missiles on each of its 12 operational Trident submarines to carry conventional warheads. The resulting force would consist of 450 Minuteman ICBMs, 12 Trident submarines in operation and two in overhaul, 56 B-52 bombers and 21 B-2 bombers. The United States could then adjust the warhead loadings on its remaining ICBMs and SLBMs to retain a force of up to 2,200 operationally deployable nuclear warheads.

Hence, the United States still plans to maintain a sizeable and varied force of more than 2,000 strategic offensive nuclear warheads. Nevertheless, the administration has argued that this force may not be sufficient to meet the security challenges of the future. The United States appears to be seeking the ability to attack promptly, at great range, with focused intent, and with less destructive force than it would have used in attacks against the Soviet Union.

Issues and Implications

The Bush administration has outlined a number of programs and initiatives that could contribute to tailored deterrence. These include plans to modify some Trident SLBMs to carry conventional warheads; plans to develop a new "Robust Nuclear Earth Penetrator" reentry vehicle, plans to develop and deploy missile defenses, plans to convert some ICBM missiles to carry conventional warheads, and others. It also has reportedly developed a new doctrine for joint nuclear operations and new operational plans that would guide the use of US nuclear weapons in contingencies with nations other than Russia.[25] For many analysts outside government, these initiatives represent a dangerous trend in US nuclear weapons policy, with the United States ever more likely to attack a growing list of nations, possibly even preemptively, with nuclear weapons, when the United States is not threatened with a nuclear attack itself.

Many analysts, including officials speaking for the Bush administration, argue, in contrast, that the new doctrine, targeting strategy, and weapons programs are designed to enhance, not undermine or replace, deterrence. They note that a US threat to attack with nuclear weapons would not be credible if the United States did not have the plans and weapons needed to implement the threat. In particular, if the United States could only attack with relatively large and inaccurate nuclear weapons, which would cause excessive collateral damage, or if it did not have the capability to destroy the selected targets, then the adversary might not believe a US threat to respond with nuclear weapons. Therefore, by increasing the perception of the US ability to attack, the tailored deterrence options would increase the credibility of the US threat and reduce the likelihood of a conflict occurring.

The United States has, for more than 40 years, assumed that precise and certain attack plans were critical to maintaining a credible deterrent. However, this was not the only factor in a determination of whether deterrence was credible. Going back to the game theory origins of *strategic deterrence*, the United States and Soviet Union had a *mutual* deterrent relationship. Each knew what the consequences of its actions were likely to be, each knew the chances of achieving its objectives, each knew the possible costs of the other nation's response to its actions, and each was relatively certain that it would not suffer those consequences if it did not act in the first place.

The existence of a credible attack plan does not necessarily translate into the communication of a credible deterrent threat. In future crises, the United States may not have the time or the channels to inform a potential adversary of the types of actions that might result in a nuclear or conventional response from the United States. Further, the administration seems to place a high priority on developing the capability to react promptly, with little or no warning, at the start of a conflict, either to preempt the adversary's use of weapons of mass destruction or to undermine the adversary's ability to prosecute the conflict on its own terms. These may be laudable war-fighting goals, but some would argue they are not consistent with the precepts of *strategic deterrence*. In particular, they presume that the United States would act *before* the adversary had taken the actions that the United States had sought to deter. There is no promise that the adversary would not suffer the consequences and costs of its attack if it refrained from action; if anything, the adversary may feel pressured to act even more quickly, before the United States launched its preemptive attack.

Implications for the Intercontinental Ballistic Missile Force

When announcing the results of the Nuclear Posture Review, the Bush administration indicated that the United States would retain a triad of ICBMs, SLBMs, and heavy bombers for the foreseeable future. It did not, however, offer a rationale for the retention of this traditional "triad," even though the points raised in the past about the differing and complementary capabilities of the systems probably still pertain. The absence of a rationale makes it difficult to predict possible future trends in the ICBM force. The 2006 QDR recommended that the Air Force reduce its Minuteman III force to 450 missiles. However, it is not clear whether this is the beginning or the end of possible changes in the Minuteman III force. The United States can still retain 500, or more, warheads on ICBMs by retaining some missiles with more than a single warhead. But as few as 150-200 missiles could also carry 500-600 warheads. In addition, the United States could deploy Trident SLBMs with more than the three or four warheads that each is likely to carry as the United States reduces to the limits in the Moscow Treaty, further reducing the number of warheads allocated to ICBMs.

The concept of tailored deterrence does not offer any guidance for the size of ICBM force. If anything, it seems to argue for a smaller force with fewer warheads to implement attacks against a specified, and presumably small number, of targets, rather than a balanced triad of ICBMs, SLBMs, and heavy bombers. The plans to convert some nuclear-armed ballistic missiles to carry conventional warheads could also affect the preferred size of the ICBM force. The QDR specifically advocates the conversion of Trident II missiles, in the near term, but the Air Force has also pursued plans to deploy conventional munitions on modified ICBMs. However, most analysts agree that both ICBMs and SLBMs with conventional warheads would provide the United States with a "niche" capability, and would not require forces of more than 50 or 100 missiles. In the absence of a rationale for nuclear-armed ICBMs, this number could represent the entire ICBM force.

Hence, in the absence of a Soviet or Russian threat, and in the presence of a growing concern about other nations that might threaten the United States, the rationale for a force of 500 Minuteman III ICBMs seems to have eroded. It is not clear whether

the concept of tailored deterrence, if it truly serves as the basis for sizing and structuring US nuclear forces, will produce a requirement for more than a few hundred, or even a few dozen, ICBMs. Thus, even if the concept of tailored deterrence does little to alter the basic precepts of US nuclear strategy and doctrine, it may, eventually, go a long way to altering the ICBM force that served a central element of the US strategic deterrent during the Cold War.

The views represented in this article are those of the author and do not reflect on the Congressional Research Service or the Library of Congress.

Notes:

[1] *Report of the Quadrennial Defense Review* (Washington, DC: US Department of Defense, February 2006), vi.

[2] Ibid., vi.

[3] Thomas C. Schelling, *The Strategy of Conflict,* (Cambridge, MA: Harvard University, 1960), 6.

[4] Caspar Weinberger, Secretary of Defense, *Annual Report to Congress, Fiscal Year 1985* (Washington, DC: US Department of Defense, 1 February 1984), 27.

[5] David A. Rosenberg, "US Nuclear War Planning, 1945-1960," in *Strategic Nuclear Targeting*, eds. Desmond Ball and Jeffrey Richelson (Ithaca, NY: Cornell University Press, 1986), 44-45.

[6] Desmond Ball, "The Development of the SIOP, 1960-1983," in *Strategic Nuclear Targeting,* ed. Desmond Ball et al., 62-65.

[7] Ibid., 69.

[8] Ball and Richelson, *Strategic Nuclear Targeting*. See also Matthew G. McKinzie, et al, *The US Nuclear War Plan: A Time for Change* (Washington, DC: Natural Resources Defense Council, 2001), 5-14.

[9] Statement of John T. Chain, Jr., Commander in Chief, Strategic Air Command and Director, Strategic Target Planning, US Congress, House, Committee on Armed Services (Washington, DC: 6 March 1990, prepared text), 5.

[10] These target categories were described in several unclassified documents during the 1990s. See, for example, US Congress, Congressional Budget Office, *The START Treaty and Beyond* (Washington, DC: October 1991), 11-25.

[11] Frank Carlucci, Secretary of Defense, *Annual Report to Congress, Fiscal Year 1989* (Washington, DC: US Department of Defense, 18 February 1988), 54.

[12] *A National Security Strategy of Engagement and Enlargement* (Washington, DC: The White House, February 1995), 1.

[13] *A National Security Strategy for a New Century* (Washington, DC: The White House, October, 1998), 6.

[14] Craig Cerniello, "Clinton Issues New Guidelines on US Nuclear Weapons Doctrine" *Arms Control Today* 27, no 8 (November/December 1997).

[15] Jeffrey R. Smith, "Clinton Directive Changes Strategy on Nuclear Arms; Centering on Deterrence, Officials Drop Terms for Long Atomic War," *Washington Post,* 7 December 1997, A1.

[16] David B. Ottaway and Steve Coll, "Trying to Unplug the War Machine," *Washington Post,* 12 April 1995, A28.

[17] Jeffrey R. Smith, "Clinton Directive Changes Strategy on Nuclear Arms; Centering on Deterrence, Officials Drop Terms for Long Atomic War," *Washington Post,* 7 December 1997, A1.

[18] Statement of the Honorable Douglas J. Feith, Undersecretary of Defense for Policy, US Congress, Senate, Committee on Armed Services. (Washington, DC: 14 February 2002).

[19] Donald H. Rumsfeld, Secretary of Defense, *Annual Report to the President and the Congress* (Washington, DC: US Department of Defense, 2002), 83.

[20] *Report of the Quadrennial Defense Review* (Washington, DC: US Department of Defense, February 2006), 30.

[21] Jason Sherman, "Henry: Quadrennial Review will Advance "Tailored Deterrence" Concept," *Inside the Pentagon* 21, no 50 (15 December 2005).

[22] US Department of Defense, *Special Briefing on the Nuclear Posture Review*, news transcript, 9 January 2002.

[23] Statement of the Honorable Douglas J. Feith, Undersecretary of Defense For Policy, US Congress, Senate, Committee on Armed Services (Washington, DC: 14 February 2002).

[24] *Alternative Futures Approach to Nuclear Deterrence Planning* (Washington DC: US Defense Threat Reduction Agency, July 2002). Cited in Hans M. Kristensen, *Global Strike: A Chronology of the Pentagon's New Offensive Strike Plan* (Washington, DC: Federation of American Scientists, 15 March 2005), 104-105.

[25] Walter Pincus, "Pentagon Revises Nuclear Strike Plan," *Washington Post*, A1 (11 September 2005); William Arkin, "Not Just a Last Resort? A Global Strike Plan, With a Nuclear Option," *Washingtonpost.com*, 15 May 2005; and Hans M. Kristensen, "The Role of US Nuclear Weapons; New Doctrine Falls Short of Bush Pledge," *Arms Control Today* 35, no 7 (September 2005).

Amy F. Woolf (BA, Political Science, Stanford University; MPP, Public Policy, John F. Kennedy School of Government at Harvard University) is a Specialist in National Defense in the Foreign Affairs, Defense, and Trade Division of the Congressional Research Service at the Library of Congress. She joined CRS in April 1988, and provides Congress with information, analysis, and support on issues related to nuclear forces and arms control. She has authored many studies and participated in numerous seminars on these issues, addressing such topics as the nuclear weapons strategy and doctrine, strategic arms control and the US-Russian arms control agenda, ballistic missile defense policy and the ABM Treaty, and issues related to nuclear weapons and threat reduction in the former Soviet Union. Ms. Woolf has spoken at numerous conferences and workshops, discussing issues such as Congressional views on arms control and ballistic missile defenses, cooperative threat reduction with Russia, and US nuclear weapons policy.

Ms. Woolf spent a year at the Department of Defense, working on the 1994 Nuclear Posture Review. Before joining CRS, Ms. Woolf was a member of the Research Staff at the Institute for Defense Analyses (IDA) in Alexandria, Virginia. Prior to her tenure at IDA, Ms. Woolf worked on arms control and defense policy issues as a research associate at Systems Research and Applications Corporation in Arlington, Virginia.

Essential for Success: A Systems Approach
(A Declaration of Interdependence)

Col Robert Carl Shofner
Commander, 526 ICBM Systems Wing
Hill Air Force Base, Utah

John L. Clay, Vice President and General Manager
ICBM Prime Integration Contract
Northrop Grumman

One definition of military doctrine is *what we believe and teach about warfare*. We update and modify this doctrine as time passes but certain elements are enduring as fundamental principles. For example, unity of command is as essential for success in warfare today as it was when it and other principles of war were first documented several centuries ago.

As in warfare, successful weapons system program management also depends on adherence to fundamental, enduring principles. In short, to succeed, we believe the program team must have four capabilities that are mature and robust: *system engineering, process discipline, system domain knowledge, and integration.* All are necessary for success. Missing any one creates a significant program risk. In the intercontinental ballistic missile (ICBM) development, production, and sustainment world, we call the combination of these four elements *a systems approach to program management.*

Of course, adherence to these four fundamentals alone does not guarantee success. To guarantee success programs also require quality planning, stable budgets, baselined requirements, mature technology, and so forth. Along with those requirements, the four fundamentals contribute significantly to the success of delivering capability on-cost and on-time. We also do not claim to be the only program management team employing a systems approach. To one degree or another, the necessary elements of the systems approach must have been present to accomplish any major systems solution, ranging from the Great Pyramids to the Panama Canal. Indeed, we believe programs only succeed through its application even though they may not use the systems approach term. Likewise, programs that fail to meet expectations most likely fall short in one or more of the essential *systems approach* capabilities.

The context of our experience is the ICBM program. We observe that ICBMs have been successfully developed and sustained for more than fifty years. Our heritage is the Atlas, Thor, Titan, Peacekeeper, and Minuteman missiles. These systems:

- Were successfully fielded and maintained
- Experienced no major acquisition failures
- Achieved a high degree of mission success
- Met military and political objectives

One of the most successful programs on record is the Peacekeeper missile. Peacekeeper achieved an unprecedented 18 successes out of 18 flight tests during Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) and, despite significant political issues related to the basing mode, achieved IOC seven years after full scale development was approved. Today, the Minuteman III missile has experienced just one in-flight failure in the last 35 development and demonstration flight tests. Further execution of approximately 30 small to large Minuteman III modernization programs (including two designated as ACAT 1D) is on track. To a large extent, we attribute these successes, past and present, to a systems approach.

General Bernard A. Schriever and Dr. Simon Ramo.

The history of the ICBM weapons system includes a dynamic set of leaders who possessed the skills, knowledge, and insight to fully develop the systems concept. Key among these individuals were Trevor Gardner, Assistant Secretary of the Air Force, General Bernard A. Schriever, Commander of Air Research and Development—Western Development Division, and prominent scientists, Dr. Simon Ramo and Dr. Dean Wooldridge. This core group possessed the systems engineering expertise, scientific discipline, technical knowledge, and program management skills required to instill the systems approach culture and methods while simultaneous-

ly fielding complex, successful weapons. A constant theme was subordination of the individual components to achieve optimization of the whole. These developers of ICBMs aggressively implemented and significantly refined the systems approach for managing the design, production, and deployment of large ICBM programs. Today, our ICBM program team implementation of the systems approach is based on four interdependent components necessary for success: systems engineering, process discipline, domain knowledge, and integration.

The current strategic land based deterrent is comprised of 500 Minuteman III missiles located at three missile bases. The acquisition and sustainment responsibility associated with ensuring the readiness and military relevance of this missile force is now held by the 526 ICBM Systems Wing and the ICBM Prime Integration Contract (IPIC), both located at Hill AFB, Utah. We take this responsibility very seriously and are committed to the fundamentals of the systems approach that are our heritage. Although the systems approach has evolved through time, it still consists of the four primary necessary components introduced during initial ICBM development.

First, Systems Engineering

The ICBM Program Office *Project Officers' Manual*, published in July 1976, defines systems engineering as follows; "System engineering management provides an integrated approach to the engineering management of the total system to ascertain and maintain technical integrity of all elements of the system."

Systems engineering applies a holistic approach to identifying and designing a solution by considering the entire envelope and life-cycle in which the intended solution must operate. It includes the application of trade-offs, scrutiny, and analysis to refine and optimize the solution within defined objectives and parameters (i.e., cost, delivery, performance, etc). Systems engineering is the cornerstone of the systems approach in that it employs many different disciplines to generate and refine ideas that potentially contribute to the solution. These disciplines not only include the traditional "hard" and "specialty" sciences, but also include the softer sciences, such as business, human resources, and others.

Systems engineering relies on proven reliable methods to decompose a problem, develop and integrate alternatives, and test and validate real world solutions. Much more can be said on the discipline of systems engineering, especially the significant acceleration in productivity that has occurred as a result of information technology breakthroughs such as computer-aided design, modeling, data management, and so forth. But suffice it to say, systems engineering still focuses on optimizing and integrating a "best" solution using a disciplined and reliable method.

Systems engineering is not just for new developments. In fact, for a mature system like Minuteman III, systems engineering is as important as ever. For example, the Minuteman III requires a steady flow of parts, materials, components, and even major subsystems to ensure its continued readiness (accuracy, availability, survivability, and reliability). Among our greatest risks is the possibility of introducing into the system a replacement item that fails to meet one of numerous requirements. We have a number of examples where components were initially believed to be compatible with Minuteman III but were subsequently found not to have met a significant requirement. Fortunately, in each case, a back up systems engineering review, test, or inspection found the problem before Minuteman readiness was impacted. A very important part of our engineering culture is that nothing will be introduced into the Minuteman system unless it has been subjected to the appropriate review.

A discussion of systems engineering would be incomplete without mentioning culture. The experienced systems engineer looks for problems. If it can go wrong, it will. Every data point that is out-of-family is a gift—an opportunity to catch a potential problem before it becomes a real one. Systems engineers pour over test and factory data looking for the unusual; no irregularities are dismissed, but rather are investigated until the root cause is known. We must never be comfortable with assuming an anomaly was just a random event.

We resonate with a number of studies and reviews that have reaffirmed the importance of systems engineering in our space business. One of the best tutorials on systems engineering can be found in the July 1976 ICBM Program Office *Project Officers' Manual.* Indeed, the need for systems engineering is not new and, as it was in the past, is still fundamental to the successful fielding and sustainment of any large system.

Second, Process Discipline

Process is second on our list of system approach fundamentals. Good processes and process discipline are the foundation and enabler for all activities. Without these, activities are personality dependent and ad hoc. Processes are unfairly associated with overly bureaucratic procedures; but in fact, the opposite is generally more onerous. The worst bureaucracy is where the individual contributor doesn't know what to do, how to do it, or how to get it approved. Process definition allows people to understand their roles and what they need to do to succeed.

Process definition and discipline provides consistency and repeatability. To be effective, processes must first be documented and standardized. The natural order of process development is define, implement, execute, and improve. Where there is no standard there can be no improvement. This cycle is continual.

During the last fifty years a strong and robust understanding of process discipline has emerged on a global scale. Champions like Deming, Juran, Crosby, Ohno, Shingo, and Goldratt have brought forward new thinking to help create a process discipline body of knowledge. Today, process discipline is viewed as a mature methodology. Frameworks such as ISO-9001, AS9100, and CMMI along with various other standards are used to establish the structure for process discipline. Within that structure, improvement methodologies such Lean (kaizen), Six Sigma, and theory of constraints are used to refine and evolve processes and operations along a continuum of capability.

Our long term partnership, starting in the 1950s at the Ballistic Missile Organization and more recently under the fifteen year ICBM Prime Integration Contract, provides the stable environment to retain, practice, and improve our processes. We know that an investment in process improvement will continue to provide benefits for years to come. It is unlikely that a single process improvement will make the difference between success and failure but the cumulative effect of a robust process improvement program over time is huge. IPIC uses Six Sigma as its primary mechanism for change while the 526 ICBM Systems Wing uses the Lean methodology. The 526 ICBM Systems Wing participates in many Six Sigma activities such as an IPIC initiative to reduce the time to resolve production line issues on one of our depot partnership life extension programs. Likewise, IPIC participates in Lean initiatives with the wing such as the current initiative to reduce procurement process timelines. Both Six Sigma and Lean have proven to be very effective for the program team.

Risk Management is an excellent example of a key ICBM program team process area. The ICBM Risk Management System (RMS) was developed in 1998 at the onset of the IPIC contract to address the need for risk-based sustainment of the Minuteman III and Peacekeeper. Its development began with customization from the methodologies described in the DoD Guide for Risk Management and has evolved through its use by the program team's extensive network of contractor, subcontractor, and government participants working together to manage and maintain the weapon systems. It is a highly dynamic system with more than 300 open risks that are reviewed and prioritized monthly by the entire program team. It is an essential process that allows the 526 ICBM Systems Wing and Air Force Space Command to apply their scarce resources in terms of budget and personnel toward the highest priority issues. The ICBM RMS has been shared in many forums including the DoD Defense Acquisition University where it was cited as "offering the most innovative RM policy and procedures" in their *Risk Management Guide for DoD Acquisition.* Additionally, at their request, the Air Force Space Command Civil Engineering Flight (AFSPC/CEF) and five Space and Missile Systems Center (SMC) integrated product teams have received training on the ICBM RMS. The RMS is a prime example of how well-structured, disciplined processes contribute to successful management of large scale, complex systems.

Third, Domain Knowledge

Domain knowledge is a deep understanding of the system including its components, capabilities, limitations, successes, failures, design history, and trades. It is needed for both day-to-day routine support of the weapon system and modification programs, and to respond to major issues, potential hazards, and anomalies. Unlike many other disciplines, domain expertise on a complicated system like Minuteman III cannot be created in a year or even ten years. It is the product of decades of experience and a robust knowledge management program. Domain knowledge is a team sport—it requires expertise in a wide range of engineering disciplines (e.g., propulsion, guidance, electronics, structures, thermal dynamics, nuclear surety, etc.) and system components (e.g., ground, air vehicle, systems, etc.). Retention of domain expertise is not guaranteed. In fact, it is a significant risk area for strategic systems as concluded by the March 2006 Defense Science Board Task Force Report on *Future Strategic Strike Skills.* For this reason, we actively manage domain expertise on our ICBM team.

Our Minuteman III system is very complex and at the same time, given it is a nuclear weapon system, we must be risk-averse. We have to be. The missile includes more than 50,000 pounds of solid propellant, a post-boost vehicle with highly combustive hypergolic fuels, seven flight batteries, dozens of ordnance devices, and one or more nuclear weapons. The system includes more than 5,000 configuration items, uncountable parts (guidance alone has more than 19,000) and more than a million pages of technical orders. Each missile must be capable of standing alert in a safe and secure mode for years, yet be ready to launch in just a few minutes.

Today, we are fortunate to have a critical mass of domain expertise. Most of our engineers have years of Minuteman experience. Solving today's issues often requires us to draw on events that occurred years ago such as test anomalies, manufacturing waivers, near-failures, subtle system requirements, or complex interdependencies. As an example, a major guidance issue was recognized in 2001 after several flight tests revealed an accuracy problem with the newly-fielded NS-50 guidance set. The errors were statistically undeniable. However, finding the root cause in the highly complex Minuteman III guidance and control hardware and software required many months and a large

team of highly experienced guidance experts. The team that eventually found the source of the errors was comprised of current and retired Minuteman engineers. After recommendations from the comprehensive review were implemented, subsequent flight tests validated the corrective action.

Retaining domain expertise is a key ICBM program team function. It requires an understanding of all the technical disciplines needed to ensure the readiness and nuclear surety of the weapons system and a succession plan to prepare the next generation. We maintain and update these plans regularly. In addition, we also must be ready to call on the larger community (other parts of our companies, government laboratories, and retired employees) to help us respond to major anomalies and issues. Minuteman III domain expertise has benefited from a stable and long term relationship between the Air Force and industry.

Fourth, Integration

Last but not least, the final element of the systems approach is integration. In simple terms, integration is the function of ensuring all activities are coordinated in an effective way to achieve the system objectives. However, in practice, integration is anything but simple. Integration is the last defense against the well-meaning, independent action that results in unintended and harmful effects.

Integration occurs, in a very significant way, in the technical arena. It is easy to understand that components must fit together and software packages must properly pass data and commands. But this is only a small piece of the overall integration task. It also must occur at many other levels. Resources need to be available in the right place at the right time including properly trained and staffed organizations, dollars, facilities, and government furnished property. Obviously, schedules must be integrated so tasks are performed in a predictable and efficient manner.

When the term *Minuteman* is used, most visualize a 60 foot missile. But the missile is only a small part of the weapon system. The system also includes people, industrial capabilities, technical orders, engineering data, training facilities, support equipment, factory equipment, spare parts and components, transportation and handling equipment, missile alert and launch facilities, real property, and more. What many fail to understand is that changing any one of these individual elements will have an effect on all the rest. Further, the effect on all other elements of a change in one area must be understood and addressed before the change is approved.

Currently underway is a great example of ICBM integration. Today there is ongoing activity to field nine large and dozens of small-to-medium modifications for incorporation into the ICBM fleet. In fact, today is the busiest period of ICBM deployment since the first fielding of Minuteman III in the early 1970s. Rocket motors, post boost vehicles, guidance kits, re-entry systems, C2 equipment, advanced communication, security systems, environmental control systems, new cryptology, and many smaller mods are all moving to the missile fields. Each deployment requires a maintenance team and security force. Many of the mods have interdependencies so coordination of schedules, resources, and technical baselines is absolutely critical. Both hardware and software are involved. Deployments are very expensive and the

missile wings have limited resources. Security considerations are paramount and therefore add another dimension of complexity. The solution to this complex deployment challenge is a coordinated team of personnel from the missile wings, system wing, depot, and contractors who all know the plan, coordinate their activities, and operate in unison. They also have the ability to rapidly respond to issues. The good news is that the ICBM team anticipated these challenges, developed comprehensive plans, and management tools, and is working effectively to keep the major upgrades to Minuteman fully integrated.

Integration works in concert with and is a close cousin to the other elements of the systems approach. In fact, if the organization has strong systems engineering, process discipline, and domain knowledge, integration is achieved more easily.

In Conclusion …

We are confident that no one will find great controversy in our assertion that a systems approach is critical to success in the management of a large weapons system and that it does not occur naturally. However, what may be more thought provoking is the task of determining the extent to which a systems approach exists on a given program and the likelihood that it will be maintained and improved in the future. Claiming the existence of capable systems engineering, strong processes, domain expertise, and integration is easy to do but the substance may be missing. So, how can you tell if in fact the four necessary components are firmly in place? What evidence would one expect to see? There are a number of positive results that should be readily apparent; notably the absence of chaos, the smooth realization of robust engineering solutions, solid cost and schedule performance, a high degree of mission success and customer satisfaction, consistent and repeatable processes, fluid movement of capable human resources, flexibility and adaptability to an ever changing landscape, and most importantly, the resilience to recover from and permanently correct the problems that inevitably do occur.

One final word of caution is in order. Although the merits of a systems approach may appear to be obvious, there will always be the potential for activities to operate outside the construct. The less experienced will see the systems discipline and rigor as

unnecessary and an impediment to progress. While well-meaning, those who attempt to operate in this fashion are focused on optimizing at the subsystem or component level and not at the system level. Early on, it takes less time and resources to manage a subsystem if the fundamentals of the systems approach can be ignored or relaxed. The problem is, of course, that once the wayward subsystem or component is introduced into the system, unintended consequences manifest themselves. Unfortunately, the list of past failures from wayward activities is very long. We call critical activities that operate outside the systems approach *orphans*. Our goal is to eliminate all orphan activities and bring them back into the systems family.

General Schriever and his team of early ICBM pioneers deserve much credit for their contributions to the systems approach. Indeed, we are extremely fortunate to have their work as our heritage. The systems approach is a time proven construct for successful management of large weapon systems and it continues to be refined and improved. It is a holistic framework of four key necessary elements that we believe must exist in order to ensure successful acquisition and operation of complex systems.

Colonel Robert Carl "Shof" Shofner is the Commander of the 526th Intercontinental Ballistic Missile Systems Wing, Ogden Air Logistics Center, Hill Air Force Base, Utah. The 526th is responsible for integrated systems management for Minuteman and Peacekeeper weapons systems from inception to retirement. The 526th directs all ICBM development, acquisition, modification, sustainment, and deactivation activities. The 526th also manages and controls development and acquisition programs to upgrade the Minuteman weapon system and extend its operational life.

Colonel Shofner received his commission after completing the Air Force Reserve Officers Training Corps program at the University of South Carolina as a distinguished graduate. He entered active duty in 1982 and has served in a variety of program, staff, and headquarters positions.

He has served on the staff of the Secretary of the Air Force, managed programs and funding for the Nation's most sensitive space systems, conducted worldwide demonstrations and analysis of various Air Force warfighting capabilities, and led the modernization of the Nation's premier weapon systems.

Prior to his current assignment, Colonel Shofner was the Materiel Group Director for the US Airborne Warning and Control System.

John L. Clay (BS, Engineering Mechanics, US Air Force Academy; MS, Business Administration, Wright State University) is Vice President and General Manager of the ICBM Prime Integration Contract for Northrop Grumman. He has more than 30 years of acquisition and management experience.

Mr. Clay leads the industrial team given the responsibility by the Air Force to sustain and modernize the Nation's ICBMs. The team was awarded the prime integration contract on 23 December 1997.

Previous to his employment with Northrop Grumman, Mr. Clay served in the US Air Force, retiring with the rank of Brigadier General. During his final assignment, he was Director of Space and Nuclear Deterrence, Office of the Assistant Secretary of the Air Force (Acquisition), in the Pentagon, Washington, DC.

Before serving in the Pentagon, he was Vice Commander, Headquarters Space and Missile Systems Center, Air Force Materiel Command in Los Angeles, California.

In addition, Mr. Clay successfully served in eight program offices supporting the acquisition of aircraft, weapons, space and C3 systems. During this time, he directed two major acquisition programs, the Navstar Global Positioning System, and the National Airspace System.

Strategic Deterrence In An Uncertain World

Dr. Clayton K. S. Chun
Chairman, Department of Distance Education,
US Army War College

Intercontinental ballistic missiles (ICBMs) and the concept of deterrence were largely synonymous with US Cold War strategic nuclear policy. Deterrence is a tool to influence the decision-making of one actor by another. It came into being as a way to accomplish an end, to maintain peace in a nuclear-armed world. The concept of deterrence is not new and it does not require nuclear weapons or ballistic missiles to enact. In many respects, the confrontation between Soviet and American strategic nuclear arsenals was simple; a nation only had to acquire and maintain sufficient military capabilities to deter its opponent from conducting a full-scale nuclear attack. Arms control efforts helped reduce nuclear tensions by forcing Washington and Moscow to scrap whole classes of delivery vehicles and thousands of warheads. However, both sides continued to rely on potent nuclear strike forces, including ICBMs, despite these efforts. A combination of these forces, effective policy, diplomacy, political will, and a bit of luck allowed deterrence to function properly and avoided a nuclear conflict.

Today, the Soviet Union no longer exists. Although the Russian Federation maintains a sizeable force of ICBMs and other weapons from its Cold War inventory, it is not the force it once was. But other nuclear powers have risen since the collapse of the Soviet state. The People's Republic of China has a small but growing nuclear inventory. North Korea and Iran may pose problems regionally and globally with their ballistic missile and potential weapons of mass destruction (WMD) programs. India and Pakistan possess nuclear weapons and ballistic missiles that may not be a direct threat to the United States, but their rivalry could create serious regional problems and might impact our national interests. Unlike the Cold War, Washington's first exposure to a nuclear threat, the Nation faces a wider set of potential threats. The United States must now provide capabilities to defend the country against several nations with ICBMs, submarine launched ballistic missiles (SLBMs), cruise missiles, or other weapons capable of conducting a direct attack on the United States.

Today's strategic calculus is more complicated than the Cold War. Will the Russian Federation one day attempt to revive its former military glory and expand its nuclear forces in an attempt to become a superpower once again? Will China expand its strategic forces to increase its influence not only in Asia, but globally as well? Will smaller powers that develop a modest nuclear capability use them to blackmail regional rivals and threaten US interests? Will non-state actors, like terrorist groups, acquire a nuclear device and destroy an American city? These threats will grow while the United States also faces increasing conventional military and insurgency challenges worldwide.


Department of Defense

What type of role will ICBMs play in the future? Strategic deterrence will continue to be a viable policy for the United States, but the role of ICBMs will evolve.

Despite the need for strategic deterrence and ICBMs, some critics argue that the Nation can and should reduce its reliance on nuclear weapons and ICBMs. The Global War on Terrorism has focused the Nation's attention primarily on non-state actors who do not possess the same capabilities of nations like Russia or China. The value of ICBMs and its nuclear response to deter terrorists seems limited. Others argue that the world can eliminate or limit nuclear weapons with effective arms controls, non-proliferation treaties, and other international agreements and control. This would allow the United States to eliminate its remaining ICBMs and

SLBMs. Despite the spread of nuclear technology, information, and weapons, proponents of these views believe that countries can dissuade their thirst for WMD and pursuit for appropriate delivery systems. Vocal critics point to the questionable utility of nuclear weapons due to their immoral nature in pushing for their demise. Others argue that an American nuclear response to a smaller nation's WMD release would not deter that country from using its weapons. If a regional power launches a nuclear strike against an ally, would the United States risk a nuclear confrontation over this situation?

The United States has tried to mitigate some of these new threats. For example, it has created a limited ballistic missile defense system to protect against a variety of threats. The creation of a ballistic missile defense system, however, in some minds signals a loss in confidence that the Nation's ability to deter a launch of an ICBM or tactical ballistic missile, potentially armed with WMD, is weaker than during the Cold War era. Opponents of ballistic missile defense argue the system eliminates the "balance of terror" psychology that made deterrence work.[1] Despite arguments that a limited ballistic missile defense shield could protect the Nation against an accidental launch, the United States never deployed a long-term anti-ballistic missile system in the Cold War but instead relied on a triad of deterrent capabilities.[2]

Why then, should the country continue to develop, improve, operate, and maintain an ICBM capability? The United States has reduced greatly its ICBM force from a Cold War high of 1,054 missiles to less than half of those systems. The US Air Force has scrapped its newest ICBM, the Peacekeeper, and no longer maintains multiple independently targeted reentry vehicles (MIRVs) on its missiles. Air Force ICBM and long-range bomber crews no longer maintain Cold War alert levels. With the Cold War over, what role should ICBMs play in US national security policy? Are these weapons a fading anachronism of a by-gone era? One approach to explore these questions is to examine the future of strategic deterrence. If deterrence and nuclear weapons are relevant today, then ICBMs may retain a useful role in the 21st century.

Why Strategic Deterrence?

For the United States, the advent of nuclear weapons forced the military, academic, and scientific communities to develop new strategic concepts. With the exception of the War of 1812, most of America's conflicts did not entail a foreign opponent fighting within US borders, but now Soviet ICBMs and later SLBMs armed with nuclear weapons could destroy much of United States within minutes. A new approach was needed, deterrence. Deterrence as a military strategy did not begin with the Cold War. Nations have used the threat of military force to punish or deny the actions of rivals for centuries, but the near instantaneous mass destruction potential of nuclear weapons was new. Bernard Brodie, one of the key architects of Cold War deterrence theory and strategy, noted that states used the threat of war as part of diplomacy to dissuade other countries not to take particular military or political actions that they would deem undesirable.[3] This type of strategy was characterized by Brodie as one that emphasized the status quo. Nuclear weapons and their delivery vehicles were developed not to fight and win wars, but to prevent them. During the Cold War, the strategy of deterrence prevented the outbreak of total war by threatening a massive nuclear retaliation and later mutually assured destruction. Although cases of conventional deterrence have failed throughout history, the situation involving nuclear deterrence seems to have worked.

Deterrence has several faces. Herman Kahn, another early Cold War nuclear warfare theorist, defined three deterrence types.[4] Type I deterrence policy was to use the threat of retaliation to avoid a direct attack on a nation. The United States was focused primarily on this type of deterrence to avoid a devastating Soviet nuclear attack. The Air Force and Navy had to possess a second strike capability to withstand and react to the initial attack. A nation may also use Type II deterrence to persuade a foe from taking a provocative action that was not a direct attack on the United States. For example, Washington protected North Atlantic Treaty Organization (NATO) countries in Europe from invasion by Warsaw Pact members under an extended nuclear umbrella during the Cold War. Countries can also implement Type III deterrence, a "tit-for-tat" or a graduated scheme, that would raise the stakes of an enemy action to an unacceptable level. If a foe takes an action, then its opponent might escalate its response with a military or other action that is too costly for the offending nation. All three deterrence types were used by the United States with varying levels of success during the Cold War.

Deterrence works if a nation can demonstrate that the cost of a rival's action is greater than any benefit it might gain from a possible deed. An attacker must make a risk/return calculation concerning the gains from a military action to the losses by retaliation from a defender. To ensure an attacker makes these calculations, the defender must convince the attacker that it has the will or credibility to punish a transgression and the capability to conduct a suitable response. During the Cold War, the United States bolstered its deterrent credibility through published policy, training, exercises, dedicated budgets, and public commitment to ICBM, SLBM, strategic bombers, and command and control systems. The Strategic Air Command maintained a bevy of weapon systems, including ICBMs, ready to rain nuclear retaliation on multiple targets at a moment's instance.

Along with capability and credibility, the concept of deterrence depends on an assumption of rationality between the relevant parties. The state that desires to deter the actions of another must transmit a message of its intention that the other can easily understand. The targeted state must make a connection between its decisions to take an action and the resulting punishment or denial it will receive in return. According to deterrence advocates, rationality leads to predictability and stability among nations. If a country used deterrence strategy to avoid nuclear war, then it must have had a good understanding of the value system of its opponent. The United States abhorred the thought of Los Angeles or Dallas being destroyed in a nuclear exchange during the Cold War. Destruction of innocent civil-

ian population centers was too terrible to contemplate, but it did offer a mutual vulnerability that United States leadership could exploit to enforce deterrence with its Soviet counterparts. United States leadership hoped the Soviets felt the same.

For decades, Americans believed that mutual fear of retaliatory nuclear attacks on cities and other targets would prevent a nuclear conflict, but this belief was not entirely correct. Post-Cold War studies of Soviet archives indicated that leadership in Moscow never fully accepted strategic deterrence concepts, but instead believed nuclear war was winnable.[5] They did not launch a nuclear attack, however, perhaps because they still considered elements of deterrence in their deliberations. For example, in the 1980s strategic competition between Washington and Moscow heated up. Attempts to counter the Reagan administration's rapid military build-up stretched an already overburdened Soviet economy to the point of collapse; the perceived gains from a renewed arms race with Washington were not worth the effort. Attempts to match American strategic and conventional force expansion failed.

Some critics point to other countries that may not be influenced by a deterrence policy. In the future, would states like North Korea or Iran value a particular objective more than they feared the potential destruction of their cities or other targets? For example, would the spread of radical Islam through revolution or the destruction of Israel by Iran be worth a nuclear response against a city like Teheran? A challenge for United States political and military leadership is to determine the values each country holds dear in order to create an effective deterrence strategy.

The United States was able to implement a strategic deterrence policy for the Soviet Union because its forces could survive an initial preemptory nuclear attack. Effective deterrence rests on the ability of a nation to launch a punishing second strike. Both the United States and the Soviet Union craved a stable relationship, in terms of avoiding a possible massive nuclear exchange, which required some additional capacity and duplication to conduct operations after an attack. Washington believed that deterrence or at least the presence of large and capable retaliatory forces stopped Moscow from launching a preemptive strike during the Cold War. Agreed limits to strategic defenses, verification regimes, and mutual vulnerability offered both countries the ability to ensure each side could destroy the other with a second strike. This twist of avoiding war through vulnerability seemed alien. If one nation tipped the balance of strategic power by employing more or better ICBMs or other weapons that negated any passive or active defenses, then the level of vulnerability was disturbed and deterrence threatened. Still, the process seemed to maintain the status quo and avoid nuclear war.


Department of Defense

Determining what motivates or affects regional powers' behavior is vital to deter countries like North Korea.

The strategic environment has dramatically changed. The dissolution of the Soviet Union and the development of nuclear weapons capabilities by additional states have complicated US national security strategy. Can the United States, with its ICBM and SLBM forces, effectively implement deterrence policy as it did in the Cold War? Detractors might argue that Washington cannot deter nations like Iran or North Korea that eschew threats of punishment. Either their national leadership does not believe the United States has the will to react to aggressive action on their part or the benefit from taking an action outweighs the cost of any possible reaction by Washington. Other countries may base their national policies on different views of rationality and ideology and present more complex challenges to deterrence strategy and the future role of ICBMs.

Former Defense Secretary Casper Weinberger added two other conditions for deterrence: clarity and safety.[6] The nation needs to make clear its policies and approach. An unambiguous public national security strategy, directives, and other policies that inform opponents of the consequences of certain actions would make clear the nation's intentions. This approach allows opponents to understand what actions are found objectionable and the response they will receive. Similarly, nuclear delivery systems must have procedures and structures in place to avoid accidental launches or unauthorized weapons releases. A challenge faced by the United States is misinterpretation of its policy by other WMD states. Leaders from Teheran to Pyongyang may interpret Washington's policy differently from its intended purpose. These misinterpretations could weaken deterrence and lead to unintended confrontation or conflict.

Strategic Deterrence in a Globalized World

In today's complex world, the United States faces a range of challenges that makes a strategy of deterrence more complicated to employ. While the types and conditions of deterrence defined in the Cold War are still pertinent, conditions have changed significantly to force the country to view the strategic landscape through a different set of lenses. US national security leadership must consider a number of diverse actors that view their security requirements differently than others. Similarly, nations that were not the primary focus of US security interests in the past are now the focus of the Nation's attention. Understanding their motives and views of Washington's concerns and intentions are new features of the security environment. International ambition, historical

animosity, political motivation, domestic concerns, religious ideology, proliferation of various types of weapons, culture, and other factors drive different "rationalities" and affect the risk/return calculations that make deterrence work.

The policy of strategic deterrence used in the Cold War may still work with Russia and China, but may not be effective against North Korea or Iran. Instead of a single deterrence policy, Washington must have several. Unlike the Cold War, the Nation has to create a series of deterrent policies crafted for specific conditions and countries. This approach to deterrence will force Washington to rely on a wider number of options. Deterrence works if one can create conditions that would discourage particular actions based on an opponent's particular interests, capabilities, culture, ideologies, and other factors. America faces a world troubled by historic, ethnic, territorial, and religious conflicts that were contained during the Cold War, but have now bubbled to the surface. Globalization has further strained relations among nations. With the information revolution, globalization has sped economic disparity and rapid cultural changes that have forced the United States to confront more and complex security situations, including deterrence policy.

Kahn's three levels of deterrence continue to serve as a framework to explore strategies today. Despite arms control efforts, negotiation, and America's status as the world's sole superpower, there are states that have deployed or will soon have the capability to launch a direct attack on the United States. Type I deterrence policy is still germane to the future on American security policy. Military forces must have the ability to deter a direct attack on the United States. Current ballistic missile defense systems are not designed to protect the Nation from a determined attack by a country with large numbers of ICBM or SLBM forces that could swamp interceptors or radar systems. A foe can also employ ballistic missile countermeasures, MIRVs, or maneuverable reentry vehicles to undercut defenses. The US' Cold War triad of ICBMs, SLBMs, and strategic bombers has been largely reduced primarily to an ICBM and SLBM force for the nuclear mission. Long-range bombers have the capability to deliver nuclear weapons, but their primary mission today is mostly conventional as witnessed in Iraq and Afghanistan. While the possibility of a massive nuclear attack on this Nation today is slight from Russia or China, other countries are cause for concern in the future. America does face nations that have or desire to build nuclear inventories that can reach the continental United States.

One of the major problems globalization has wrought to the world is the proliferation of technologies that states can manipulate to build nuclear weapons and delivery systems. Rapid information transfer, potential availability of nuclear technology and materials from Russia, former Soviet clients trying to earn hard currencies to replace lost Moscow subsidies, and countries attempting to gain new political alliances by helping other states through weapons transfers have successfully spread ballistic missile and WMD capabilities to several countries. These transfers have created regional powers that can now cripple their rivals using a small number of ballistic missiles. These types of systems may not offer a direct devastating threat to destroy American society, but may do so to allies and have a direct effect on US' interests.[7] During the Cold War, Washington could offer an effective shield to Allies or others to protect them from such a peril, so-called "extended deterrence." Today, the spread of nuclear and other weapons across the globe to countries that we never considered very important has become a significant problem for US policy makers. With a smaller ballistic missile force and a more complex set of conditions to release nuclear weapons, political and military leadership face difficult decisions to ensure protection of regional allies under Type II deterrence. Type II deterrence can help reduce the threat of regional conflicts.

Kahn's last deterrence scheme, Type III, seems quite viable in today's strategic environment. A regional power that deploys WMD or has a conventional military force that could threaten a neighbor raises many troubling questions. The possession of a wide range of military capabilities, to include ICBMs, offers Washington the ability to confront a threat with different levels of response. Regional powers have a limited range of military options generally confined to their geographical areas. The United States has the ability to ratchet-up several levels of options, from sanctions, blockades, air strikes, ground force deployment, and a limited nuclear release. A potential adversary may think carefully about conducting an unwelcome adventure against US interests knowing that Washington may respond with a reaction beyond its capability to counter or makes the activity too costly.

Critics could argue that smaller countries may not believe that the release of nuclear weapons by the United States, short of a direct attack on sovereign American soil, is credible. During the Cold War, questions arose about the use of nuclear weapons under a form of deterrence, the policy of massive retaliation. In this instance, the slightest provocation by the Soviet Union or by one of its client states was supposed to lead to a direct, large-scale US nuclear strike. The concern leaders in Moscow had to address was at what level of provocation Washington would respond with nuclear weapons, given the nuclear preponderance that the United States maintained in the 1950s when this policy was in effect. Soviet leadership would need to weigh a host of factors for each contemplated action. The same strategic calculation takes place today. However, the 2006 *National Security Strategy* adds a further twist for states to consider. The United States could "act preemptively" to prevent another country from threatening this country or friendly nations with WMD.[8] This added condition provides some level of credibility and added pressure that the Nation could use a Type III deterrent scheme in the future, at least where WMD apply, without an attacker initiating an action.

Strategic deterrence has a definite role in the post-Cold War era. The road protecting the United States must now expand from a single lane of largely protecting the country from direct attack from Russia or China to additional lanes to cover a rogue state's ballistic missiles or WMD attack and potential conflicts in areas of interest around the world. During the Cold War, the United States considered Kahn's Type II and III deterrence

schemes, but they were not as predominant as Type I. Still, the United States did offer its nuclear umbrella to NATO and other countries. Today, Type II and III situations are the primary concern.

The Future of Nuclear Weapons

After the demise of the Soviet Union, the United States and the Russian Federation began a series of agreed reductions in nuclear delivery systems and warheads under the Strategic Arms Reduction Treaty II and subsequent agreements. To some, the world seemed to be on the verge of eliminating most nuclear weapons. Unfortunately, other nations did not contribute to the disarmament effort and Russia and the United States would never have totally disarmed. China, India, and other nations have enhanced their nuclear arsenals and delivery systems. In 1998, Pakistan admitted and demonstrated their former secret nuclear weapons program; North Korea has claimed it has a nuclear weapons inventory; and, Iran has gained key nuclear technologies that could aid it in building a weapons program. Iran or North Korea may deploy nuclear tipped ICBMs to deter an attack on their own soil. Developing a nuclear retaliatory ability might allow Iran or North Korea to take a more active foreign policy or to take actions that they would never have contemplated without these means. Iranian Ambassador Gholamreza Ansari's statement "[o]ne way to avert war is to be prepared for any war" implies that his country might deter any military action against it with a significant counterweight, nuclear weapons.[9] Not only might the United States face additional nuclear armed powers in the future, but several countries also have biological and chemical weapons that could provide a devastating blow against potential enemies or indirectly against targets these foes might prize.

The United States faces a very uncertain world with countries that maintain weapon systems, ideologies, and objectives that can directly and indirectly threaten American national interests. US leaders have taken steps to deemphasize nuclear weapons, such as reductions in inventories of ICBMs, lowered alert status, and elimination of entire classes of weapons like tactical nuclear systems. Should the Nation's inventory be reduced even more? Despite these actions and reductions by Russia, the spread of weapons, albeit in smaller total numbers and yields relative to the Cold War, still provides many challenges to the United States. Some observers believe that the proliferation of these weapons should be seen in a positive light. The spread of nuclear weapons among smaller regional powers might provide a deterrent effect that would provide stability. But if deterrence fails, a small scale nuclear fight could erupt. Additionally, if one power has a nuclear weapon or other WMD, then it could start a preventative war to deny a rival's attempt at gaining the same capability or it could launch a preemptive strike if its leadership perceives a foe will soon attack.[10] These alternatives are troubling.

Given the current and future range of potential threats to the United States, the country needs to preserve its capabilities to respond to a variety of threats. Although precision conventional attacks could destroy potential WMD sites or intimidate smaller states, the United States must still have the capability to counter larger and rising nuclear armed states. A recent RAND Corporation study postulated potential military options that China could pursue to counter the transformation of American military capability. One scenario indicated a massive Chinese build-up of ballistic and cruise missiles that could overwhelm Taiwan, strike American military forces and bases in the Asia-Pacific region, and conduct conventional strikes against strategic targets in the United States.[11] There are several responses the United States could take. One alternative is "escalation deterrence." This option involves presenting an absolute dominance of military forces at every level to react to any Chinese move that puts targets from economic targets to military forces at risk of attack.[12] The United States could use the threat of a limited or massive nuclear strike on cities or military forces to dampen Beijing's ambitions, much like Kahn's Type III deterrence.

The threat to use nuclear weapons also provides a counter to nations that might use WMD. During the 1991 Persian Gulf War, coalition nations were concerned about the possible release of chemical weapons by Saddam Hussein. The Iraqi military was warned by the United States that it would retaliate massively if WMD was used.[13] Whether Washington would have responded with nuclear weapons is speculation; however, Hussein had to consider this possibility.

Credibility is the key to deterrence. Some critics argue that the threat to use nuclear weapons to deter chemical weapons is merely a bluff. In the future, Washington might have to respond to a chemical or biological weapons release. Conventionally armed ICBMs, cruise missiles, traditional long range strategic strike aircraft, and other means provide additional credible options for the Nation to exercise. ICBMs with improved guidance, kinetic energy from ballistic reentry, and high explosive warheads could allow the Nation to destroy WMD sites or ballistic missile launch sites without using a nuclear weapon. The availability of conventional weapons options raises the credibility of a potential deterrent response, especially if no attack was made on American soil. Having conventional and nuclear options is more credible than a nuclear option alone. ICBMs are a swift and difficult weapon to defend against; however, there are some issues concerning their use. Aside from depleting a limited inventory of ballistic missiles, coordination with other nuclear powers is necessary, depending on their launch path, to avoid deadly miscalculation.

Passive and active defenses against WMD attack on the United States or its allies also may reduce the threat of nuclear "blackmail." Smaller nuclear powers that deploy a limited capability to strike at the United States might be dissuaded if their capability is neutralized. A limited ballistic missile defense shield could reduce the threat from a nation with only a few ballistic missiles even further, but allow countries with ICBM or SLBM inventories to maintain their deterrent capability relatively intact.

Deterrence as a Policy for Tomorrow

The use of a deterrent force, nuclear or conventional, is still viable and necessary. Although most recent and past studies of

deterrence focused on nuclear forces, the use of conventional forces has a longer history. Stationing land, air, and naval forces in Western Europe and South Korea during the Cold War forced potential aggressors to consider the consequences of engaging US forces. Today, national and military leadership need to consider an even wider range of potential conflicts and options than in the Cold War.

Some states will continue to make decisions based on "rational" risk-return calculations similar to Cold War deterrence policy, but others may not. Leaders from smaller powers, with different goals, objectives, culture, opinions, and controlling different military capabilities, may contest the United States over a number of regional issues. Some may threaten to use WMD and challenge the core of deterrent policy—the credibility of a retaliatory response. These countries might threaten to attack another country or try to develop the capability to destroy at least one city in the United States despite the presence of ballistic missile defenses. The US' massive conventional and nuclear superiority would then be muted by smaller nations that have a lesser capability.

The maintenance of conventional and nuclear forces, command and control, and appropriate infrastructure to operate a deterrent force are still vital. The additional challenge for the United States is to understand the mind of a state leader whom we want to deter. Without knowing what incentives or motivations drive a country's leadership, the United States cannot develop an appropriate response to an individual act. Deterrence in the 21st century requires a series of policies geared toward individual states and each policy will need continual adjustment. To enact such options, the United States requires a broad inventory of capabilities from ICBMs to counterinsurgency forces. This should include a larger role for conventional systems with hard target kill capability against underground command and control centers and WMD storage sites. Conventionally armed ICBMs could even strike terrorist training camps or underground command bunkers. The country will require not only more flexible use of ICBMs, but improved intelligence access and command and control capability to respond to WMD release or other actions. These capabilities will enable national and military leadership to use ICBM and other strategic forces more effectively in a dynamic world. In two decades, we have moved from a relatively straightforward deterrence policy aimed at the Soviet Union to one where deterrence has a more varied explanation and application.

The opinions expressed in this article are those of the author alone and do not necessarily reflect the opinions of the US Army War College, the US Army, the Department of Defense, or any other branch of the US Government.

Notes:

[1] Keith Payne, "Cold War Thinking Hinders Missile Defense," *Defense News*, 17 April 2006, 45.

[2] The Nation did build a single Safeguard anti-ballistic missile system in North Dakota in 1975. The system reached initial operational capability in April 1975 and was fully operational on 1 October 1975. It was deactivated the next day.

[3] Bernard Brodie, *Strategy in the Missile Age* (Princeton, NJ: Princeton University Press, 1965), 270.

[4] Herman Kahn, *On Thermonuclear War* (Princeton, NJ: Princeton University Press, 1961), 126.

[5] Keith B. Payne and C. Dale Walton, "Deterrence in the Post-Cold War World" in *Strategy in the Contemporary World: An Introduction to Strategic Studies*, ed. John Baylis, et al. (Oxford: Oxford University Press, 2002), 174-175.

[6] David Miller, *The Cold War: A Military History* (New York, St. Martin's Press, 1998), 84-85.

[7] Regional nuclear or WMD powers could hit American deployed forces or threaten other national interests like key economic or political concerns.

[8] George W. Bush, *The National Security Strategy of the United States of America* (Washington, DC: The White House, March 2006), 18.

[9] "Iran Tension: Suicide Bombers Sign Up," *Financial Times*, 18 April 2006, 1.

[10] Kenneth N. Waltz, "The Spread of Nuclear Weapons: More May Be Better" in *Conflict After the Cold War: Arguments on Causes of War and Peace*, 2nd edition, ed. Richard K. Betts (New York: Pearson Longman, 2005), 434.

[11] James C. Mulvenon, et al., *Chinese Responses to US Military Transformation and Implication for the Department of Defense* (Santa Monica, CA: RAND Corporation, 2006), 95.

[12] Ibid., 126-127. The United States could use limited nuclear strikes to a massive counterattack to counter any move by Beijing. However, this option could escalate out of control if not exercised with restraint.

[13] Michael R. Gordon and General Bernard E. Trainor, *The General's War: The Inside Story of the Conflict in the Gulf* (Boston, MA: Little, Brown, and Company, 1995), 353.

Clayton K.S. Chun (BS, University of California, Berkeley; MS, University of Southern California; MA, University of California, Santa Barbara; Ph.D., RAND Graduate School) is chairman of the Department of Distance Education at the US Army War College, Carlisle Barracks, Pennsylvania. He is a retired Air Force officer with assignments in missile, space, education, and strategy development. Dr. Chun is the former holder of the General Hoyt S. Vandenberg Chair of Aerospace Studies at the Army War College. He has published widely in the areas of national security, space and missile history, military history, and economics.

Deterrence: Cold War to Tailored
It Is Time To Think Differently

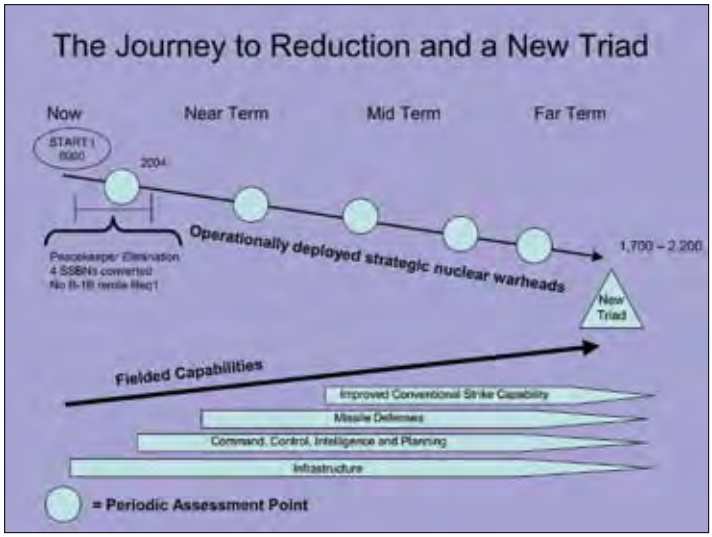
Lt Col George R. Farfour
Commander, 595th Operations Support Sq., 595th Space Group, Space Innovation and Development Center

It has been more than four years since the Nuclear Posture Review (NPR) made its debut recognizing a new triad of capabilities to protect the United States.[1] Sadly, few outside the "nuclear world" know what it is; much less can speak with assurance on the subject. So confused are the experts, it is equally criticized as the US placing both *more* and *less* reliance on nuclear weapons at the same time.[2]

Time after time, we are charged to think differently about nuclear weapons in this post-Cold War era, yet most still rely on a Cold War dialectic when judging the usefulness of nuclear weapons and their contributions to national defense.[3] Many experts are increasingly being viewed as jealously guarding weapons of the past that continue to drain valuable resources from other more "relevant" weapon systems.[4] Despite the criticisms, current policy validates the nuclear deterrent as a "…keystone of National Power."[5]

As military budgets become further constrained, the call for a more relevant and cogent argument for nuclear weapons as a part of the new triad will continue to grow. Those who care about such matters must step out briskly with new ideas which recognize our Nation's current threats as well as its capability short-falls. Recent history has shown the type of painful choices our leadership must make between people and programs and offsets within programs. Indeed, it is truly time to think differently.

The new triad envisioned by the NPR sets up a framework that integrates all elements of our military capabilities (current and future) into a model recognizing a wide-range of possibilities. Those possibilities assume that improved capabilities of conventional strike, missile defenses, command and control, intelligence and planning and a responsive defense infrastructure will enable the environment to reduce the numbers of our operationally deployed nuclear weapons. Thus, future capabilities would allow for the reduction of nuclear weapons. From a strictly military viewpoint, only fielded capabilities, properly enabled by enhanced intelligence and planning can truly be relied upon to make the new triad more than just a good idea.



The new triad also seeks to fill the current capability gap—the lack of military options between a nuclear intercontinental ballistic missile (ICBM) in 30 minutes and a Joint Direct Attack Munition in 24-36 hours.[6] When combatant commanders' talk of prompt global strike (PGS) options, capabilities within that gap are normally what they are talking about. Some efforts to water down the capability by applying current or near-future air breathing options does not keep focus on the technology and capabilities needed to answer the types of threats within that gap.[7] In other words, for the foreseeable future, PGS is not a capability within the technology of an aircraft.[8]

In no other sphere of National Security are forces so closely linked to policy as in the area of deterrence policy. At its most basic level, deterrence policy is necessarily grounded in the mind of the adversary or potential adversary. In this case, the old military adage sums it up well, in deterrence as in war, "the enemy gets a vote."

The advent of capabilities-based force structuring has confused military and political experts and has proven especially problematic when trying to explain or justify advanced weapon systems to the public at large. The definition of the capabilities-based approach as it translates into force planning leaves a lot to be desired, "…[an] approach focuses more on how the United States can defeat a broad array of capabilities that any

adversary may employ rather than who the adversaries are and where they may engage joint forces or US interests."[9] Under this definition, the decision-making process which evaluates whether a weapon system will be fielded and program prioritization is equally abstract. The recently released *National Security Strategy of the United States of America* is presented in a threat-based format as capabilities-based explanations at the highest level are troublesome and impractical.[10] But attempts to explain implementation of capabilities-based systems devolve into less concrete formulations as implied by US Strategic Command Commander General James E. Cartwright, "…the new triad concept was sound in principle, but that the pace of attaining the new construct was lagging the national need."[11]

One way to navigate beyond this seeming Gordian knot is to consider the concept of tailored deterrence. Tailored deterrence is a term used to describe nuclear and non-nuclear options designated to expand the traditional concept of nuclear deterrence and adapt it to other strategic situations.[12] Established as a term in 2001 NPR, it fell into disuse, almost immediately from its introduction due largely to the attacks on 11 September 2001 and the focus on the Global War on Terrorism. One cannot escape however its lack of a firm definition and the inability to match the concepts behind the term with warfighting capabilities.

The 2006 Quadrennial Defense Review (QDR) sought to expand the understanding of the term:

> "The Department is continuing its shift from a "one size fits all" notion of deterrence toward more tailorable approaches appropriate for advanced military competitors, regional WMD states, as well as non-state terrorist networks. The future force will provide a fully balanced, tailored capability to deter both state and non-state threats—including WMD employment, terrorist attacks in the physical and information domains, and opportunistic aggression—while assuring allies and dissuading potential competitors."[13]

The concept of a tailored deterrent is the best way to explain how our forces can navigate the future with capabilities that serve to anticipate numerous unknown threats. With the publication of the 2006 QDR, thankfully, the term is back in full favor with plans and funding to back up and give some teeth to the concept only understood completely in the context of a new model of national security.[14]

Based primarily on the future anticipated capabilities needed for multiple unknown adversaries, the NPR recognized the uncertainties of deterrence alone by continuing the 2001 QDR theme of a graduated state of play in policy goals, namely, the "assure, dissuade, deter, and defeat" model.[15]

The model reclassifies existing political realities into new policy goal areas. The inevitable observation that the model simply recognizes existing realism in national security policy has been made. Certainly, whether a new paradigm or recognizing reality, the adjustment helps to define and understand concepts within the QDRs (both 2001 and 2006) and the NPR. While not inclusive, each of the policy goals is explained below.

- *Assure Allies and Friends* through credible non-nuclear and nuclear response options which support US commitments throughout the world. In addition, defenses would be employed to protect security partners and forces which are projected forward. And lastly, maintain second-to-none nuclear capability which assures allies and the public.
- *Dissuade Competitors* through a diverse portfolio of capabilities which would deny a payoff from competition with the US. This point recognizes the fact that currently, non-nuclear strike favors the US and that the competitive edge for the infrastructure for both supporting current systems and developing future systems is with the US.
- *Deter Aggressors* through non-nuclear and nuclear options which provide a tailored deterrent. Further, defenses discourage attack by frustrating an adversary's attack plans. A responsive infrastructure improves US capabilities to quickly counter emerging threats.
- *Defeating Enemies* is explained by employing strike systems which can neutralize a full range of enemy targets as well as defenses which would provide protection if deterrence fails.[16]

The "assure, dissuade, deter, defeat" policy goals have become more understood with the passage of time. While not mutually exclusive, each work together and support each other in a way which blurs the definitional lines between them. Thus, some of the precepts of traditional deterrence overlap the concept of dissuasion and vice-versa. They work together in a continuium within the four spectrums of the model. This fact only strengthens the whole model rather than isolating each into a stovepipe. Here is where we are challenged to expand our thinking beyond historical policies and our own mind-set to something not totally new, but taking sound underpinnings and building upon them.

Since deterrence is based on the perceptions of the adversary, tailored deterrence is even more dependent on new capabilities and their view of the usability of those capabilities.[17] Many have presented the term "usable," when referring to weapons, especially nuclear weapons as a negative term, though from a dissuasion and deterrence standpoint, it is just that concept that makes the argument relevant.[18] The more "usable" a weapon is the more deterrent value it has and thus the less likely it will be used—this is the dichotomy of deterrence.[19]

We, as a Nation need weapons to fill the current capability gap. Those weapons, along with a thoughtful evolution of our current nuclear deterrent capabilities will enable our transition to the new triad. We are slowly making progress in this arena.

Transitioning our current nuclear forces into multi-mission platforms is the most credible way to contribute to the required changes necessary to evolve and truly become a part of a tailored deterrence concept.

Nuclear bombers are already there as they are both conventional and nuclear capable with an increasing array of lethal and precise weapons. Even the B-2, designed in the Cold War as a deep-penetrating, stealth nuclear delivery system has become a favorite of combatant commanders in its conventional role. The B-52 and B-2 have adapted so well, these platforms designed as strategic nuclear bombers can be tasked to deliver close air support, a role previously regarded as nearly impossible.

… it is imperative the NPR's grand vision with its requirements for sustained financial commitments and ongoing strategic foresight see its way from the drawing board to implementation.

SSBNs are beginning that transition with the plan to load-out two submarine launched ballistic missile (SLBM) tubes with conventional capabilities.[20] More conventional dedicated SLBM tubes would have an even greater impact toward contributing to tailored deterrence and the reduction of nuclear warheads.

Air Force Space Command is deeply involved in a myriad of plans to find new conventional uses for our ICBM capabilities. Possibilities ranging from near-term deployments on the coasts to futuristic common aero vehicles on perhaps some of our inland based ICBMs, demonstrate there is no shortage of ideas.[21] The commitment to make them more than ideas has yet to be made. Thinking differently in this area has proven particularly challenging, especially with lawmakers.[22] The programs capabilities above are just a few of the ways we are redefining the capabilities of the future, but we have a long way to go.

These efforts are a great start, but in order to fully realize a tailored deterrence model we need to close the current capability gap and continue to push the technological envelope. As with any major redefinition of policy and forces, there are challenges.

Two major challenges stand in the way of military capabilities to meet the requirements of enabling the tailored deterrence concept. The first is the omni-present concern of funding. If tailored deterrence is to be realized, it must have a sustained commitment of investment in not only current systems that can become more relevant, but in the testing of new technologies. The historical cycle of design, testing, and fielding of weapons capabilities is insufficient to answer the Nation's future needs.[23] Congress and the American people must be convinced of the utility of the programs and shown how they directly influence tailored deterrence. As the time-proven Washington truism explains, 'vision without funding is a fantasy.'

Secondly, we must be careful to be realistic in our expectations and stay within practical and pragmatic technical solutions. The military, especially the Air Force is seen as enamored with technological solutions and must not become overly fascinated with the "next new thing" at the expense of the art of the possible. This does not mean truncating ideas and thoughtful programs which can serve the greater good. However, aiming too far over the horizon in this budgetary constrained environment can spell disaster for otherwise desperately needed capabilities for the warfighters which ultimately give greater flexibility and more robust options for the President.

The NPR set out a new vision for the strategic environment of the United States. The changes the NPR advocates are a watershed event in national strategy in an area all but ignored since the end of the Cold War.[24] Add to that vision of a new triad, the concepts of tailored deterrence, fully embraced by the 2006 QDR, and we have a much clearer picture of what is needed to fill the current capability gap. However, often it is easier to bend steel than bend the mind to new ways of thinking.

Realizing a far-reaching vision under the most favorable conditions is difficult. Add to that the fiscal constraints faced by today's policy makers, it is imperative the NPR's grand vision with its requirements for sustained financial commitments and ongoing strategic foresight see its way from the drawing board to implementation. We must enable that debate with fresh ideas that are not confined to Cold War frameworks. We are called upon to lead the charge to evolve strategic deterrence to enable tailored deterrence. If we fail, we will most certainly afford the President fewer options and perhaps make war more likely. It is truly time to start thinking and acting differently. If we don't, who will?

Notes:

[1] J. D. Crouch, "Special Briefing on the Nuclear Posture Review," briefing slides, 9 January 2002; Donald H. Rumsfeld, Nuclear Posture Review Report Letter of Transmittal/Unclassified Executive Summary, undated.

[2] Ibid; Amy F. Woolf, "US Nuclear Weapons: Changes in Policy and Force Structure," CRS Report for Congress, Congressional Research Service, The Library of Congress, 23 February 2004; C. Paul Robinson, A [Sandia National Laboratories] White Paper: Pursuing a New Nuclear Weapons Policy for the 21st Century, 22 March 2001, http://www.sandia.gov/media/whitepaper/2001-04-Robinson.htm (accessed on 1 June 2006); *Nuclear Posture Review: What It Says…and What It Means*, Nuclear Reduction/Disarmament Initiative, The Churches' Center for Theology and Public Policy, http://www.nrdi.org/nuclear/FinalNPR.htm (accessed on 1 June 2006); Thomas B. Cochran, et al., *Faking Nuclear Restraint: The Bush Administration's Secret Plan For Strengthening US Nuclear Forces*, Natural Resources Defense Council Backgrounder, 13 February 2002; National Institute For Public Policy, *Strategic Offensive Forces and the Nuclear Posture Review's 'New Triad,'* March 2003; Keith B. Payne, "The Nuclear Posture Review: Setting the Record Straight," *The Washington Quarterly*, Summer 2005.

[3] George W. Bush, *The National Security Strategy of the United States of America* (Washington DC: US Government Printing Office, March 2006); Department of Defense, *Quadrennial Defense Review Report*

(QDR), 06 February 2006; Stephen J. Cimbala, *Nuclear Weapons and Strategy: US Nuclear Policy for the Twenty-First Century*, (London and New York: Routledge, 2005); General Lance W. Lord, "Strategic Deterrence: Evolving Our Mindset and Capabilities" (speech for the National Defense University's Congressional Seminar Series, Capitol Hill, Washington, DC, 20 April 2005); Richard A. Paulsen, *The Role of US Nuclear Weapons in the Post-Cold War Era* (Maxwell AFB, AL: Air University Press, 14 September 1994); Tom Sauer, *Nuclear Inertia: US Nuclear Weapons Policy After The Cold War* (London & New York: I.B. Tauris, 2005); James J. Wirtz and Jeffrey A. Larsen (eds.), *Nuclear Transformation: The New US Nuclear Doctrine* (New York, NY: Palgrave MacMillian, 2005).

[4] Cochran; *Nuclear Posture Review: What It Says…and What It Means*.

[5] *QDR*, 6 February 2006.

[6] Perhaps even longer if we have to fight our way in and out of the target area; Michael R. Gordon, "Pentagon Seeks Nonnuclear Tip For Sub Missiles," *New York Times*, 28 May 2006.

[7] John A. Tiroak, "Washington Watch: Eight Bomber Prospects…," *Air Force Magazine*, June 2006, 16, 18; Statement of General James E. Cartwright, Commander United States Strategic Command Before the Strategic Forces Subcommittee, Senate Armed Services Committee On Global Strike Plans and Programs, 29 March 2006, http://armed-services.senate.gov/e_witnesslist.cfm?id=1842 (accessed on 1 June 2006).

[8] Gordon, "Pentagon Seeks Nonnuclear Tip For Sub Missiles."

[9] Department of Defense, *Joint Operations Concepts*, November 2003.

[10] George W. Bush, *The National Security Strategy*, March 2006.

[11] General Cartwright statement.

[12] Ibid; George W. Bush, *The National Security Strategy*.

[13] *QDR*, 6 February 2006.

[14] Ibid.

[15] *QDR*, 30 September 2001.

[16] Ibid.; J. D. Crouch, "Special Briefing on the Nuclear Posture Review"; Lt Col George R. Farfour, *United States Strategic Deterrence Policy 2025 and Beyond: An Examination of and Proposal for an Evolving Strategic Future*, Air Force Fellow Research Draft Paper, April 2006.

[17] Many policy experts have long held a view that because US nuclear weapons were developed and sized for a massive exchange with the former Soviet Union, that even if one of our current or potential adversaries do not believe in the credibility of US threats of nuclear use, then deterrence has already failed. This belief is well founded as numerous policy makers dismiss the use of nuclear weapons for various reasons. If the risks outweigh the use, the weapons become self-deterring.

[18] Jack Mendelsohn, "The Muddle of US Nuclear Weapons Strategy, *Arms Control Today*, October 2005.

[19] Elaine M. Grossman, "Ex-Agency Head: 'Credible' Nuclear Weapons Might Stop Proliferation," *Inside Defense*, 22 December 2005.

[20] SSBN literally means Ship, Submarine, Ballistic Missile, Nuclear Power - Nomenclature identifying the hull of a fleet ballistic missile submarine; Harold Brown and James Schlesinger, "A Missile Strike Option We Need," *Washington Post*, 22 May 2006; General Cartwright statement.

[21] Air Force Space Command, Conventional Ballistic Missile Briefing, February 2006.

[22] Amy F. Woolf, "Conventional Warheads For Long-Range Ballistic Missiles: Background and Issues for Congress," CRS Report for Congress, Congressional Research Service, The Library of Congress, 13 February 2006; Gordon, "Pentagon Seeks Nonnuclear Tip For Sub Missiles."

[23] National Institute For Public Policy, *Strategic Offensive Forces*.

[24] Payne, The Nuclear Posture Review.

Illustrations:

All illustrations taken (directly or implied) from "Special Briefing on the Nuclear Posture Review," briefing slides, 9 January 2002, presented by J. D. Crouch.

Illustration 3, quote, Donald H. Rumsfeld, Nuclear Posture Review Report Letter of Transmittal/Unclassified Executive Summary, undated.

Lt Col George R. Farfour (BS, East Carolina University, MA, Webster University, MMOAS, Air University) is the Commander, 595th Operations Support Squadron, 595th Space Group, Space Innovation and Development Center, Schriever AFB, Colorado. Immediately before taking command, Lieutenant Colonel Farfour served as a National Defense Fellow (Senior Developmental Education [SDE]) assigned to the International Security Program, Center for Strategic and International Studies (CSIS), Washington, DC. He has held a variety of operational and staff duty positions in Intercontinental Ballistic Missile operations, Satellite Command and Control, joint nuclear planning, the Air Staff and Headquarters, Air Force Space Command (HQ AFSPC). When assigned to HQ AFSPC, he served as the Deputy Director of the Commander's Action Group. While on the Air Staff, Lieutenant Colonel Farfour was responsible for strategy and concepts planning for nuclear policy and was the Air Force's Action Officer for the Nuclear Posture Review. He also was responsible for the Air Force's policy and compliance with space arms control treaties and agreements including the most politically charged treaty of the post Cold War era, the Anti-ballistic Missile treaty. Lieutenant Colonel Farfour is a graduate of Squadron Officer's School, Air Command and Staff College, Air War College (by correspondence) and in-residence SDE as an Air Force Fellow. He is a Credentialed Space Professional earning the Command Space Badge.

The Future of Strategic Deterrence

Capt Blake Bearden
Program Manager, Responsive Space Division,
Directorate of Development and Transformation,
Space and Missile Systems Center, California

The year is 2010, and the President receives an intelligence report that a nuclear-capable terrorist state is storing weapons grade, fissionable materials in a hardened underground bunker outside their capitol. A sensitive political climate and credible terrorist threats of nuclear attack against the United States have made it necessary to destroy the nuclear capability. After contacting United States Strategic Command (USSTRATCOM), an execution order is generated within the hour and a CONUS-based Minotaur-class vehicle with a conventional kinetic payload delivers a lethal kinetic shock to the storage bunker neutralizing the threat until ground troops can be deployed to confiscate the nuclear materials. This is but one of many missions a conventional deterrent can perform in support of the warfighter.

It is the mission of prompt global strike (PGS) to be able to globally strike targets and precisely apply effects on targets within minutes to hours to achieve desired effects. This need includes our ability to take out high-value, time-sensitive, and hard-to-defeat targets in an anti-access environment. With the US Air Force reducing overseas forces and an increase in air expeditionary force (AEF) structure, it has become increasingly important to provide capabilities which can put effects on target in a prompt timeline. A decreasing number of nuclear assets, combined with a traditional policy of non-use, creates a need for new instruments of deterrence. A conventional PGS asset could serve to address this new role as well as below the strategic level of conflict commonly needed in many PGS scenarios. A conventional PGS asset could serve to address this new role as well as below the strategic level of conflict commonly needed in many PGS scenarios.

During the past forty years, the US nuclear strategic deterrent has centered on a triad of intercontinental bombers combined with land- and sea-based ballistic missile forces. While the threats facing the world today have changed, our nuclear deterrent options have evolved only to the degree of standing down bomber alerts. Before we discuss possible new approaches to improving upon our strategic deterrent, it is helpful to remind ourselves of what deterrence means. The simplest definition of deterrence is preventing someone from doing something.[1] In terms of strategic deterrence, however, it is preventing the malevolent use of force by another state by threatening the use of military power.[2] The nature of military power we elect to use is the subject of this article. The changing threat environment and the general non-usability of nuclear weapons have created a gap in our strategic deterrence abilities.

The Cold War initially called for an eye-for-an-eye (mutually assured destruction, or MAD) policy against the Soviet Union. That is to say, the best weapon we can use against a nuclear weapon is another nuclear weapon used in an overwhelming way to ensure a credible and reliable deterrent capability.[3] The threat of nuclear retaliation is a powerful assertation to all that the penalty for nuclear use is unacceptably high and thus not worth the price. However, it also undermines the tradition of non-use. The United States, since 1978, has pledged the "non-use" policy against non-nuclear weapon states that are members of the nuclear Nonproliferation Treaty (NPT) (members include the United States, Russia, Great Britain, France, and China), except if attacked by a state that is allied with a state possessing nuclear weapons.[4] India, Pakistan and Israel possess nuclear weapons but are not members of the NPT. The potential exists to leverage off the past forty years of ICBM expertise and apply those technologies along with surplus booster inventories to provide solutions to needed capabilities in today's Air Force.

Conventional strategic strike could be a powerful way to demonstrate that nuclear and conventional aggression will be met with US force in a manner consistent with our current policy of non-use of nuclear weapons and with effects appropriate to a given threat.

Conventional strategic strike could be a powerful way to demonstrate that nuclear and conventional aggression will be met with US force in a manner consistent with our current policy of non-use of nuclear weapons and with effects appropriate to a given threat.[5] The first Bush administration showed emerging cooperation between the US and Soviet Union, effectively reducing superpower-sponsored aggression.[6] Yet that cooperation revealed some weakness in its inability to deter the Iraqi invasion of Kuwait. In this conflict, US strategic deterrence options had limited value in the prevention of conventional aggression, especially after the role of the USSR as a sponsor collapsed. Although the Bush administration did not rule out the use of nuclear forces in the conflict, any Iraqi threats of chemical warfare of other weapons of mass destruction (WMD) would not likely have been met with a US nuclear response.[7] The conflict illustrated that a gap in deterrence options has formed.

Today's US nuclear forces dissuade near-peer powers from a nuclear strike against the US, but lack the ability to deter non-nuclear attacks from non-state actors and terrorist groups.

New capabilities provided by conventional weapon technologies must be developed to defeat these emerging threats and provide the needed deterrence against these threats. Conventional deterrent offer a major advantage over today's high reliance on nuclear weapons. Perhaps most significant is the realistic deterrence capability conventional weapons bring since their use is seen as a more credible threat than the use of nuclear weapons.[8] Our current nuclear arsenal continues to reflect the strategic realities of the Cold War, characterized by high-yield warheads, moderate reentry vehicle accuracies, and limited earth penetration capabilities.[9] New technologies to defeat hard and deeply buried targets, improve reentry vehicle accuracy, and defeat nuclear and biological agents are needed for future systems.[10] These systems will have the capability to put effects on target from call-up in minutes to hours to provide for a PGS capability. The need for a complementary conventional strategic deterrent capability is further reinforced by long-term reductions in the number of operationally deployed nuclear warheads, per the nuclear posture review.

Future C2 will require accurate and timely targeting information to increase lethality for non-nuclear capabilities and the supporting systems and platforms. All deterrent options will require augmentation, modernization, and replacement.

Developmental studies using existing reentry aeroshells have been analyzed by Air Force Space Command and Space and Missile Systems Center to deliver conventional kinetic energy payloads. One concept delivers a large tungsten mass to impart very high shock impact to buried hardened targets. This concept can adapt today's weapon technologies into proven reentry systems and fly them atop existing booster inventories. Another type of kinetic payload currently being studied relies on up to hundreds of smaller kinetic energy projectiles which create a shotgun-like effect on the target area. These concepts can deliver a wide range of effects on both hardened and soft surface and buried targets and provide the warfighter today with a wide range of options at their disposal. With an enhanced guidance system using global positioning system, these systems will also have greatly improved accuracies compared to their nuclear counterparts and help to limit collateral damage.

An important consideration to make for the conventional strategic deterrent case involves maintaining a clear and unambiguous separation between conventional and nuclear forces. Geographic separation from existing ICBM silos will be a critical attribute for a conventional ballistic missile capability. Also, use of launch vehicles that are not part of the land based nuclear forces further differentiates nuclear and conventional force launches. It must be clear to all observers that any conventional launch is non-nuclear to prevent a nuclear response to the launch. The US Navy is currently experiencing difficulties with maintaining a clear distinction between nuclear and conventional forces with their Conventional Trident Modification. This concept employs conventionally armed Trident missiles aboard a Trident submarine with existing nuclear Trident missiles. Thus there is no difference in the signature of a nuclear armed or conventionally armed missile. Even a sophisticated nation will not be likely to have the capability to distinguish between nuclear and non-nuclear launches with this system. A land-based system could offer a clear advantage in making a distinction between nuclear and conventional forces if it maintains geographic separation and launch vehicle-type separation from existing nuclear forces. A conventional system also offers significant advantages in terms of operational considerations. With a conventional deterrent in a PGS scenario, no deployments are required and there is no need for flyovers. Multiple munitions can be flown on a single booster to engage several targets, driving down the number of shots required in a scenario.

The Trident missile, named after the trident, is an intercontinental ballistic missile (ICBM) which is armed with nuclear warheads and is launched from submarines (SSBNs), making it a SLBM.

A reentry vehicle such as a Mk 21 could be used to carry conventional as well as nuclear payloads for the next generation of strategic deterrent options.

Another consideration for a conventional strategic deterrent involves command and control (C2) improvements which need to address that the C2 signatures are sharply distinct from nuclear forces and that a prompt strike can be executed from minutes to hours and hold targets at risk across the globe. As a new arm in the strategic deterrent force is formed, requirements for C2 will become increasingly important to ensure we maintain an effective residual force structure.[11] Future C2 will require accurate and timely targeting information to increase lethality for non-nuclear capabilities and the supporting systems and platforms. All deterrent options will require augmentation, modernization, and replacement.[12]

While a conventional arm in the current strategic deterrent force could serve to complement the existing deterrent options, there are potential disadvantages to their employment. First, cost could become considerable if their employment in modern warfare becomes substantial. Unlike the procurement of

nuclear assets which are employed as deterrents, conventional deterrents will likely see more use and thus will require more replacement systems. Given the kill probabilities required by USSTRATCOM for targets within their target sets, it is likely that multiple systems would be launched against high value targets to ensure high probabilities of kill. Operations and maintenance costs will be driven by the need for dedicated manpower for around the clock operations as well as the need for geographic isolation from nuclear assets. While the cost for these systems has the potential to be costly, their potential to avoid escalation of future wars and prevent the spread of WMD and non-state terrorist activity could be well worth the system cost. When compared to the daily cost of a major theater war or the cost of a B-2, the system cost is negligible.

Another issue for a conventional deterrent in the new strategic deterrence structure involves the increased incentive for an adversary to procure a small nuclear arsenal for deterrence purposes against a conventional threat.[13] On the other hand, there would be prime targets for a US conventional system. This issue raises policy and strategy questions that need to be addressed by NPT members.

The conventional options discussed above can be used in a specific deterrence role against particular emerging threats, such as nuclear enrichment facilities or terrorist training camps. Availability of these conventional options in addition to our current nuclear deterrent provides a significantly more flexible strategic deterrence. By allowing the President and USSTRATCOM increased flexibility with non-nuclear options which can be used against non-state actors and aggressors in the world today, we can complement our existing nuclear deterrence options to create the modern strategic deterrent force of the 21st century. This force structure will dissuade aggressors from asymmetric conventional attacks, given the greater likelihood of a conventional response (as compared to nuclear weapons) by the United States in order to prevent such an attack.[14] These options need to be further refined and demonstrated to provide potential options for leave behind capability. Conventional deterrent options added to the existing nuclear inventory will allow the US to better meet the challenges of today with swift justice and continue to allow us to provide international leadership for the rest of the world.

Notes:

[1] Paul H. Nitze and J. H. McCall, "Contemporary Strategic Deterrence and Precision-Guided Munitions," Post Cold-War Conflict Deterrence, *The National Academies Press*, 1997, 1, http://newton.nap.edu/html/pcw/Dtb.htm (accessed on 1 June 2006).

[2] Ibid.

[3] Ibid., 2.

[4] "US Nuclear Policy: 'Negative Security Assurances,'" fact sheet, Arms Control Association, March 2002, http://www.armscontrol.org/factsheets/negsec.asp (accessed on 1 June 2006).

[5] Stacey Shepard, "Emerging Capabilities May Permit Fundamental Change in US Strategic Force Posture," csba online, 21 March 2001, 3, http://www.csbaonline.org/4Publications/Archive/P.20010321.Emerging_Capabilit/P.20010321.Emerging_Capabilit.htm (accessed on 1 June 2006).

[6] Paul H. Nitze and J. H. McCall, "Contemporary Strategic Deterrence."

[7] Ibid.

[8] Andrew Krepinevich and Robert Martinage, "The Transformation of Strategic-Strike Operations," csba online, March 2001, http://www.csbaonline.org/4Publications/Archive/R.20010300.The_Transformation/R.20010300.The_Transformation.htm (accessed on June 1).

[9] "Nuclear Posture Review Report," GlobalSecurity.org, 8 January 2002, http://www.globalsecurity.org/wmd/library/policy/dod/npr.htm, (accessed 01 June 2006), submitted to Congress on 31 December 2001, 46-47.

[10] Ibid.

[11] "Nuclear Posture Review Report," 15.

[12] Ibid.

[13] Andrew Krepinevich et al, "The Transformation of Strategic."

[14] Stacey Shepard, "Emerging Capabilities."

Capt D. Blake Bearden (BS, Human Factors Engineering, United States Air Force Academy; MBA, Embry-Riddle Aeronautical University) is a Program Manager, Responsive Space Division, Directorate of Development and Transformation, Space and Missile Systems Center, California. Captain Bearden serves as the subject matter expert for space force application and prompt global strike (PGS). He is responsible for the planning and development of a PGS demonstration and implementation plan and integrates efforts from the joint AF/DARPA FALCON program.

Captain Bearden was commissioned as a second lieutenant through the United States Air Force Academy in Colorado Springs, Colorado in May 2001. Prior to his current position, he served as study lead in an effort to develop the operational Common Aero Vehicle (CAV) concept for the Air Force.

Deterrence - Strike: Intercontinental Ballistic Missiles Deliver 21st Century Capabilities

Mr. Rick Baily
Vice President C3 Networks, Anaheim Site Executive,
Integrated Defense Systems, The Boeing Company

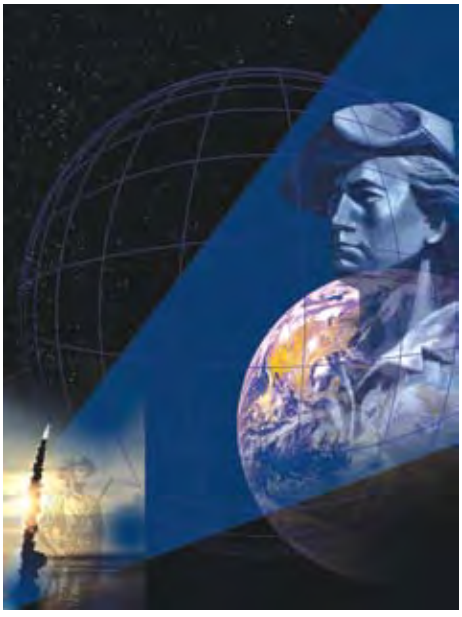
The land based intercontinental ballistic missile (ICBM) force has served as the foundation to our Nation's defense for nearly fifty years. The critical deterrent mission filled by this system remains as important as ever. Readiness and capability, hallmarks of the Minuteman legacy, continue to provide a firm basis for deterrence. This article explores two of the challenges to be met in reshaping the current land based deterrent system to meet future needs and offers opinion on what promise ICBMs might hold.

Tomorrow's challenges—global threats, ICBM industrial base erosion and annual fiscal constraints—require ever more capable and affordable land-based deterrent weapon systems.

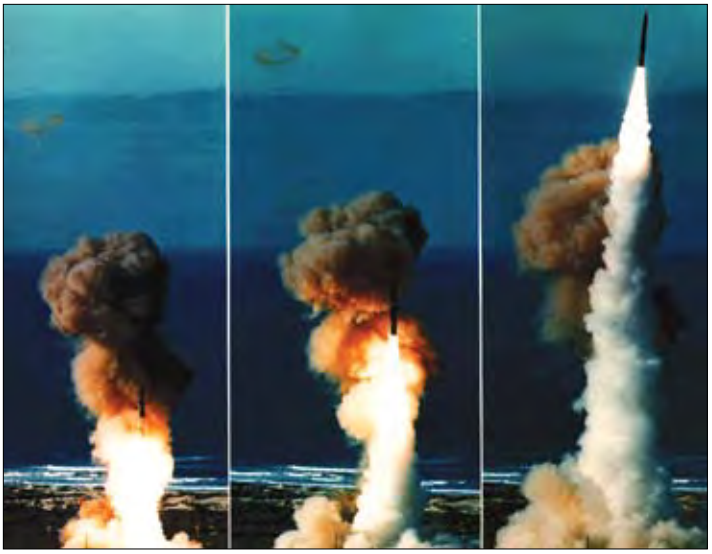
The first of these challenges is relevance in a diverse, multi-faceted, global environment. The US faces a much different geo-political environment than it did in the Cold War era. A broader range of complex nation-to-nation relationships exist. Several worrisome governments continue to pursue weapons of mass destruction and ballistic missile technologies with which to deliver those weapons. US national security policy is unwavering on the need to maintain a nuclear force of appropriate size and strength to deter aggression, assure friendly nations, dissuade others from developing weapons of mass destruction (WMD) and, if required, defeat any adversary. These needs (deter, assure, dissuade, and defeat) were drivers during the Cold War and remain valid in today's more complex global arena. Obviously, our Nation's significant conventional forces, as well as diplomatic and economic strength, provide substantial and effective tools with which to accomplish most US goals. Nuclear capabilities still provide a stable and secure foundation, underpinning our abilities to leverage our strengths while meeting our global obligations. Nuclear and conventional strike capabilities remain at the tip of the new triad.

What is the right nuclear force structure? Clearly, that's a question best answered by national leadership supported by expert defense planners. The Minuteman ICBM's widely dispersed land-based deterrent system, Minuteman, provides stability in the new triad. This dispersed basing mode creates several hundred hardened targets making attack by an adversary an expensive and unsure calculus. In the absence of the Minuteman system, the number of key strategic targets drops to just a handful. Such a low threshold might make attack on the US nuclear systems attractive enough to tempt an enemy. A strong land-based deterrent system is critical to our national defense posture.

The Minuteman system has been the subject of a number of life extending programs throughout it's nearly fifty years of watchful service. The most recent of these programs have replaced aging electronics, aging rocket motor components and propellant, and have enhanced re-entry vehicle safety. The recently completed Air Force study to develop a plan for Minuteman's future defined the key characteristics of the land based force beyond 2020. These characteristics are; increased flexibility, improved accuracy, and enhanced safety/security. However, in these fiscally challenged times, a strong focus on improved affordability is also essential. Our challenge is to continue to provide improved capability, but at a significantly lower life cycle cost. For example, missile guidance instruments, the basis for Minuteman's all inertial guidance system, have not been replaced in the current life extension programs and will be an affordability driver for system operations and maintenance. Integration of new instrument technologies into an improved Minuteman missile guidance, navigation, and control system provides a low risk path to significantly decrease day to day system costs while providing additional weapon system accuracy and enhanced weapon system security.



Life extension programs and additional research and development spending have attempted to prop up the dwindling national resource required to maintain and develop nuclear weapons and their delivery systems. The investment levels recommended by the Defense Science Board years ago have never been implemented. Nuclear skills and infrastructure are key to future readiness, but the unique skills required for ICBM guidance, navigation and control, propulsion, and nuclear command and control must also be invigorated to meet future system needs. Just as the military has made it a significant focus to create and nurture a cadre of space-skilled people, industry must prepare the appropriate development and production skills for future deterrent systems. Programs to



provide an affordable, flexible, accurate, and safe/secure Minuteman for the future must be defined, programmed and funded to attract and keep the industrial skills required for the future. Fiscal constraints faced by the Department of Defense make it imperative that Minuteman of the future be even more affordable for daily operation and maintenance.

Recent events have highlighted gaps in our overall defense posture. The capability to achieve desired effects, globally, at a time of our choosing has become more valuable than ever. The means to achieve a prompt global strike (PGS) is receiving attention and many concepts for this conventional strike capability are being evaluated by the services. The mobility, flightiness, and ever-morphing nature of today's hostile forces have driven a greatly increased urgency for a PGS capability. While the Services are exploring a number of concepts and initiatives to satisfy this need, the inherent promptness of a US coastal based missile system makes such an implementation attractive. However, filling the gap (the push to evaluate, create, and perhaps deploy such a capability) must be done without taking our collective eye off of the foundational nuclear deterrent mission. A coastal PGS missile system complements the vital land based deterrent system dispersed across the northern tier of our Nation, providing a more flexible, more appropriate, less restrictive response capability across a wider spectrum of conflict. An effective and unambiguous deterrent and strike architecture is the basis for clear understanding of our national intent on the part of our friends, allies, potential adversaries, and citizens.

The Boeing Company is pleased to have been a key contributor throughout Minuteman's history. The future of 21st century deterrent and strike systems hold promise to transform Cold War weapons and skills into those needed to meet the challenges ahead. Our heritage as the Minuteman prime development and deployment contractor, missile guidance developer, and the performer of a myriad of critical system support is an important part of company history.

We look forward to working with our government customers and partners to create a more relevant and affordable Minuteman weapon system serving the Nation's deterrent needs for many decades to come. The exciting opportunities to participate in creating, developing, and deploying a PGS missile system ensuring a ready strike capability to the warfighter will also leverage our heritage, technology investments, and proven performance record.

Deterrence and Strike—the mission remains… the legacy grows.

Rick Baily (BS and MS, Mechanical Engineering, UCLA and the University of Colorado) is Vice President, C3 Networks (Command, Control, and Communications)—part of the Network and Space Systems (NSS) organization in Boeing's Integrated Defense Systems (IDS) business unit—and the Anaheim, California, site executive host.

Mr. Baily is directly responsible for leading C3 Networks' varied activities in its addressed markets of Command and Control (IC2), Network and Information Systems (N&IS), Intercontinental Ballistic Missile Systems (ICBM), Integrated Shipboard Systems (ISS), and the Network Enabled Systems division of Boeing Australia Limited (BAL). In addition to the Anaheim and Australia facilities, he has responsibility for divisions within the C3 Networks organization located in Ogden, Utah, El Paso, Texas and Heath, Ohio.

Prior assignments include, Vice President, Battle Command Systems (BCS), Deputy General Manager for Integrated Defense Advanced Systems (IDeAS) and Deputy Program Manager of the Future Combat Systems program during the Concept Technology and Demonstration (CTD) phase.

Mr. Baily has also had a variety of program management and engineering assignments in systems product development. He also led the Rocketdyne Operations organization, which included Manufacturing, Facilities & Plant Operations, and Materiel. Project engineering assignments have included developing space power systems, missile defense technologies, and booster and upper stage liquid rocket engines.

Intercontinental Ballistic Missiles Yesterday, Today, and Tomorrow

Maj Gen Ralph Tourino, USAF, retired
Vice President Space Support and Global Strike,
Lockheed Martin Integrated Systems & Solutions

There has been a significant shift over the nearly 50 plus years of the ballistic missile existence that has changed the way intercontinental ballistic missiles (ICBMs) are acquired and sustained today. To understand the differences it is important to take a look back at how things were in the beginning, what were some of the key changes that got us to where we are today and then see what the future holds. I will do this in the context of people, process, product, and customer advocacy.

History of Ballistic Missile Organization

People

For decades the Ballistic Missile Organization (BMO), or its predecessor's organization, acquired within the Air Force Systems Command (AFSC) and sustained through the Air Force Logistics Command (AFLC), the Nation's ICBMs. The make-up of this AFSC acquisition organization was roughly 50 percent military and 50 percent Systems Engineering/Technical Assistant (SE/AT) contractor support that was provided by the former TRW. This workforce was very stable. The military assignments were usually four years and were made up of three distinct groups: missileers, acquisition officers, and officers on repeat assignments. Missileers were on their first assignment after missile combat crew duty which provided an operations flavor and experience to the acquisition process. AFSC acquisition officers were a mix of those with technical degrees on their first career assignments and higher level officers at the rank of major, lieutenant colonel and colonel with technical and acquisition experience and on their second and third assignments to the BMO. This provided significant continuity with respect to the weapons system and the established relationships with military and industry partners that also capitalized on their previous experiences, as well as their continued networks within the community. TRW, as the SE/AT contractor, was there for the long term and provided individual domain expertise in ballistic missile technologies like guidance, propulsion, systems engineering, deployment, command and control, logistics, and nuclear surety. In addition to the government people, there were a large number of contractors who both worked together on several ICBM programs over many years. The net effect was an ICBM community that understood each other, worked well with each other and knew how the government did business.

Process

Processes can be divided between external and internal. Externally, the approach to weapon system acquisition changed when the BMO leadership concept was established by its founder, General Bernard A. Schriever. The Commander was responsible for program execution both as the System Program Director for the major acquisition activity (i.e., Peacekeeper or Minuteman), as well as the oversight for all other acquisition efforts; he was also responsible to train, organize, and equip the workforce to execute the program. When the program executive officer was put in place this organization was radically changed and accountability for the program management responsibility transitioned from the commander to the program executive officer.

Internally, processes played an important role in ICBM acquisition and sustainment. The processes were well understood, disciplined, and repeatable. Also, there was a single, common set of processes across all programs. Strong, in-depth systems engineering was at the core of the disciplined processes and was especially prevalent on the small ICBM program where there were 22 associate contractors at one time with no industry integrating contractor. Integration on this program was done by the BMO. Management processes were well structured and common across all programs accompanied by regular program reviews and with common content and format. This kept the organization and functional staff current on program performance and issues and also allowed the rotation of people between programs without having to retrain them on the management or engineering processes. It provided management with significant flexibility to respond to planned or popup changes. Today, with all the acquisitions and downsizing in the aerospace industry, the number of ballistic missile-capable contractors and support contractors has been significantly reduced.

Product

Another key distinction was that the BMO was a single product type weapon system—managing ICBMs, which allowed the Small System Program Office (SPO) for individual ballistic missile systems to be supported by a large systems engineering community. We all worked on ICBMs and were a part of a community culture whose identity was the BMO and not a

particular program. We focused at the ICBM level. Thus, propulsion specialists could work on a propulsion system of any ICBM and did not limit themselves to a specific ballistic missile program. People could be moved easily across programs and everyone felt accountability for the ICBMs, as well as for the program. This organizational approach prevented barriers and ensured technical issues that occurred on one program or system were known to all other systems and programs.

Customer Advocacy

With the Cold War and a known enemy there was strong national support for the triad and all legs of the triad. This environment resulted in consistent strong customer advocacy. Strategic Air Command people were assigned to the BMO creating a long-term relationship between users and the BMO. We fully communicated among the acquisition and sustainment team, headquarters, and the missileers. Each organization also spoke with a single voice and the BMO clearly understood the criteria for success. With the end of the Cold War, sustainment of the Minuteman III ICBM has become the emphasis.

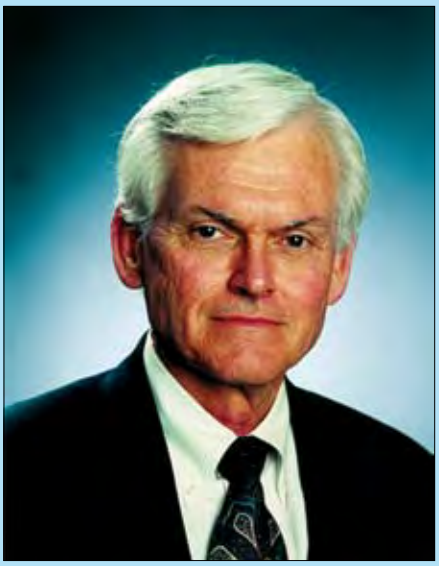
Today after Acquisition Reform

The BMO was responsible for the integration of ballistic missile systems into the operational inventory and the transition of logistic support to the Air Force Logistic Command. This historical concept was changed with the establishment of the ICBM Prime Integrated Contract (IPIC) and subsequent closure of the BMO. The ICBM modernization contracts are complete or nearing completion and a long period of sustainment performance has begun with the IPIC. The government logistic and sustainment program office has been significantly reduced in size and established at an AFLC center (now Air Material Command) co-located with the IPIC. The program office was moved to a depot and had the same industry partners but without robust government oversight. The IPIC program office's principle role is sustainment responsibility of the Minuteman III and the deactivation of the Peacekeeper ICBM.

One of the biggest changes with the elimination of the BMO and establishment of the IPIC at the logistics center is the systems engineering and integration is now primarily done by the prime IPIC contractor, with significantly reduced government oversight.

Tomorrow

The Peacekeeper missile has been deactivated. Minuteman III is still the workhorse of today's land based ICBMs—it remains on continuous nuclear alert and will continue to well into the future. However, a new mission with new technologies for the ballistic missile (need not be a 'standard' ballistic trajectory) is emerging—which is a conventional prompt global strike. New capability will provide our leaders with the ability to strike an adversary anywhere in the world with an appropriately tailored response. Conventional capability will truly compliment nuclear options in the future and, if approved for development, would warrant the establishment of a new conventional ballistic missile system program office at an acquisition center.



Maj Gen Ralph Tourino, USAF, retired (BS, Engineering, University of California at Los Angeles; MBA, Business, University of Southern California; MS, Public Administration, Auburn University; post-graduate studies for senior officials in national security, Harvard) serves as the Vice President Space Support and Global Strike Line of Business of Lockheed Martin Integrated Systems and Solutions.

General (ret) Tourino's current challenge is meeting the commitments on the programs in his Line of Business which are vital to the security of our Nation: Range Standardization and Automation (RSA) Contract and Space Lift Range System Contract (SLSRC) SE Program for the Spacelift Range; Inter-Continental Ballistic Missile (ICBM) Prime Integrated Contract (IPIC) Sustainment, Command and Control Sustainment Contracts for the Satellite Control Network, and Engineering, Development and Sustainment (EDS) Contract for Space and Missile Test and Evaluation.

General (ret) Tourino retired from the United States Air Force in 1994 after a distinguished 30-year career, principally in system acquisition. He has brought extensive leadership and management skills to Lockheed Martin. His experience spans the entire spectrum of major systems acquisitions specialties which include Space Systems (GPS, Inertial Upper Stage), ICBMs (Peacekeeper/Small ICBM) and aircraft (B-2) for the USAF, and complex command and control systems modernization for Lockheed Martin. In 1985, as a Colonel, he was the assistant deputy commander for the Small ICBM and in 1989 as a Brigadier General was the commander of the Ballistic Missile Organization.

General (ret) Tourino's management philosophy can be stated succinctly: "Empower the people to work on empowered teams. The task is to define the job, the responsibility, the resources to get the job done, and the products required. My role is to facilitate an employee's meeting my expectations within the defined constraints. I help them to be successful."

General (ret) Tourino was recently named "One of the 100 Most Important Hispanics in Business and Technology" for 2006 (also received 2003, 2004, and 2005) by the editors of *Hispanic Engineer & Information Technology* magazine.

Space Warfighting Effect

Transforming Air and Space Power
Organization in the Pacific

Lt Gen David A. Deptula
Commander, Kenney Warfighting Headquarters
Vice Commander, Pacific Air Forces

America's Air Force is rapidly transforming the way it organizes and employs combat capability. Contingency planning and execution is being normalized by a standing organization, trained and experienced in integrating multiple capabilities into viable and executable plans across the security spectrum. The organization that does this in the Pacific, and ensures US forces have optimal access to space and space-based effects is the Pacific Air Forces Kenney Headquarters (KHQ). With lineage from Thirteenth Air Force (13 AF), KHQ is the manifestation of the Air Force's Warfighting Headquarters (WFHQ) construct. As organizations and naming conventions are still in a state of transition in our Air Force, this organization can be best thought of as the Pacific air and space operations command, and will be referred to in the remainder of this article as KHQ (13 AF).

Located at Hickam AFB, Hawaii, KHQ (13 AF) is a newly established command and control organization that has been in existence since 1 June 2005. Responsible for the planning, executing, and assessing of air, space, and information operations we project peace, power, and presence in the domains of air, space, and cyberspace. During daily operations of forces assigned, the commander serves as the Commander, Air Force forces (COMAFFOR), exercising control through an Air Force forces (AFFOR) A-staff, and its own Air Operations Center (AOC). The KHQ (13 AF) commander is also positioned as the Joint Force Air Component Commander (JFACC) for air operations in the Pacific Command area of responsibility outside of Korea, and has the capability and capacity to assume the role of a Joint Task Force commander. When delegated Space Coordinating Authority (SCA), the JFACC is the single authority responsible to coordinate joint theater space operations and integrate space capabilities. In all of these cases, proper integration of space capabilities for maximum combat effectiveness is a key responsibility of the KHQ (13 AF) command.

In the deliberate planning process, space-based capabilities are integrated throughout the strategy-to-task planning process in both the Headquarters' AFFOR staff, and its AOC. Our headquarters has space weapons officers embedded in the operations directorate, strategy, combat plans, and combat operations divisions. Additionally, highly skilled space operators and technicians are assigned throughout the AFFOR staff and AOC. These space operators provide tactical-level experience in their roles as operational-level planners. In this way deliberate planning is conducted as a single process, not as separate air, space, and information processes. The imbedded space planners integrate space forces and capabilities into every phase of a plan. If the level of detail is beyond the capabilities of the planners integral to our organization, the Joint Space Operations Center (JSPOC) is available for reachback support. In any case, since control of many of the assets is not delegated to the COMAFFOR, space planners must coordinate closely with the JSPOC and other national-level organizations.

In times of crisis, the Headquarters' commander's role in integrating space capabilities is even more important. When designated JFACC with SCA, the commander is responsible for deconflicting and prioritizing space requirements for the joint force. KHQ (13 AF) planners accomplish these tasks as well. Currently, their efforts are coordinated during major exercises and contingencies by augmentees, and a temporary Director of Space Forces (DIRSPACEFOR). Originally the DIRSPACEFOR was an interim solution for use when the AOC did not have trained senior space professionals integrated into senior positions. In our headquarters that is no longer the case. There are currently 12 permanent party space operators involved in the day-to-day planning and execution of operations in KHQ (13 AF). They are critical to ensuring our planning efforts encompass all assets available for the multitude of missions we execute. In our AOC, the Deputy AOC Director is a senior space officer. With this kind of integration of air and space expertise, an augmentee DIRSPACEFOR may not be required. Accordingly, it may be time to reevaluate the need for on-call DIRSPACEFORs. In their role as a potential JFACC, all WFHQ commanders need to integrate space planning capabilities on a daily basis in their respective AOCs. Space units should send

Members from the Australian 1st Air Terminal Squadron watch the loading of equipment on to a C-17 Globemaster III 28 May 2006 at Honiara International Airport, Solomon Islands. Two C-17's from the 15th Airlift Wing and 154th Wing Hawaii Air National Guard, Hickam Air Force Base, Hawaii are helping the Australian Defense Force reposition its forces from the Solomon Islands back to Australia to better support the peace operations in East Timor.

representatives to the AOC to coordinate details with their respective units or the JSPOC exactly the same way other tactical-level unit representatives do. With this type of integration, consideration of space requirements, limitations and benefits will become standard in the planning, execution, and assessment process.

The Pacific AOC's undisputed success with space integration is well documented. Resultant Fury 04 used networked assets from the Air Force, Navy, and Marine Corps to demonstrate an all-weather capability to engage a moving maritime target. National space-based assets initially located the moving target. Satellite communications passed information to command and control aircraft, directing an airborne intelligence platform to confirm target location. With positive identification confirmed, strike assets using an affordable moving surface target engagement (AMSTE) modified Joint Direct Attack Munition (global positioning system weapon) engaged and sunk the target vessels. Space professionals throughout the Pacific AOC and AFFOR staff working with their counterpart planners in the Air Force, Navy, and Marine Corps made it happen.

US military forces will become more reliant on space-based capabilities in the future. An example of the challenges in the Pacific Rim include theater ballistic missile warning and defense for US forces and applicable partners. The absence of land- or sea-based radar coverage over vast areas in the Pacific AOR will require using the capabilities provided by space control units. These national-level assets feed the operational-level picture, enabling command and control of tactical-level units. KHQ (13 AF) planners not only integrate space assets into US missions, they are working closely with our multi-national partners to provide early warning and engagement solutions against missile threats. This coordination creates the opportunity to strengthen relationships with our partners while best using our own scarce resources.

The realm of space employment will continue to evolve. As it does, the Air Force should look at the benefits of forward basing Offensive Counter Space (OCS) units, much like we do with aircraft to project force capability and promote regional stability. OCS assets can provide a significant deterrent to aggression if properly integrated into theater information operations strategy and plans. Forward-based units also provide combatant commanders immediate theater capability, not requiring them to wait for forces to flow.

The KHQ (13 AF) provides command and control of the full spectrum of air, space, and information operations. The highly skilled team of planners integrates space capabilities throughout the entire planning, execution, and assessment process. By fully integrating air and space expertise, and moving space planning away from a self-contained cell periodically assembled for contingencies, KHQ (13 AF) is creating an environment that normalizes the JFACC as the single authority to coordinate joint theater space operations. Using its valuable space resources wisely, completely integrated into every operation, the KHQ (13 AF) is at the forefront of accomplishing the Air Force mission in terms of planning and executing missions in the domains of air, space, and cyberspace.

Lt Gen David A. Deptula (BS, University of Virginia; MS, University of Virginia) is Commander of the General George C. Kenney Warfighting Headquarters (P), and Vice Commander, Pacific Air Forces, Hickam Air Force Base, Hawaii. Kenney Headquarters is responsible for the planning and execution of air, space, and information operations in the entire Pacific theater outside of Korea. PACAF is responsible for Air Force activities over half the globe in a command with over 45,000 Air Force personnel.

General Deptula earned his wings in 1977 and has flown more than 3,000 hours to include multiple operational command assignments. He has taken part in operations, planning, and joint warfighting at unit, major command, service headquarters, and combatant command levels. He has served on two congressional commissions charged with outlining America's future defense posture—the Commission on Roles and Missions of the Armed Forces, and the National Defense Panel. Prior to assuming his current position, he was Director of Air and Space Operations, Headquarters PACAF.

General Deptula has significant experience in combat and leadership in several major joint contingency operations. He was the principal planner for attack operations for the Desert Storm coalition air campaign. He was the Combined/Joint Task Force Commander for Operation Northern Watch during a period of renewed Iraqi aggression where he flew 82 combat missions. In 2001, the general served as Director of the Combined Air Operations Center for Operation Enduring Freedom, where he orchestrated air operations over Afghanistan during the period of decisive combat. In early 2005, he was the Joint Force Air Component Commander for Operation Unified Assistance, the South Asia tsunami relief effort.

The general is a graduate of Squadron Officer School, USAF Fighter Weapons School, Air Command and Staff College, Armed Forces Staff College, and has received a second MS in national security strategy from National War College in Washington, DC.

General Deptula was recently selected as the USAF Deputy Chief of Staff for Intelligence.

Space Warfighting Effect

Military Satellite Communications – Space Force Application

Brig Gen Ellen Pawlikowski
Director, MILSATCOM Joint Program Office,
Space and Missile Systems Center

"The secret of war lies in the communication"
- Napoleon Bonaparte

For as long as there have been battles, secure and timely communication has been instrumental to success on the battlefield. As early as 1926, in *The Foundations of the Science of War,* Col J. F. C. Fuller observed, "The restrictions which the one-dimensional nature of land communications has imposed on the strategical, administrative, and tactical movement of armies have been stupendous ... During 1914-18 this limitation was the predominant factor of the war; it was no longer a question of manoeuvring to protect communications, but of increasing communications in order to move."[1]

Colonel Fuller's vision of revolutionary battlefield communications has been realized and then some. Today's battlefield communication mechanisms have evolved considerably since the use of couriers, signal flags, and drums. These early communication systems had to meet requirements analogous to the challenges faced by today's satellite communication systems. Messages had to be delivered, unaltered, and protected from disclosure to the enemy, and in time for effective action to be taken. The message couriers had to survive whatever dangers were encountered en route. Signal flags, smoke signals, and optical telegraphy required line of sight (LOS) visibility between relay stations. The relay stations themselves required protection to prevent capture by the enemy that could result in communication disruption or transmission of misinformation. All of these "requirements" and more are being addressed by the space systems acquired by the Space and Missile Systems Center in support of Airmen, soldiers, sailors, and Marines on the modern battlefield.

Space systems directly support the warfighter enhancing the effectiveness of ground and air forces. Military satellites provide five key data elements to the warfighter, all of which are critical to success on the battlefield:

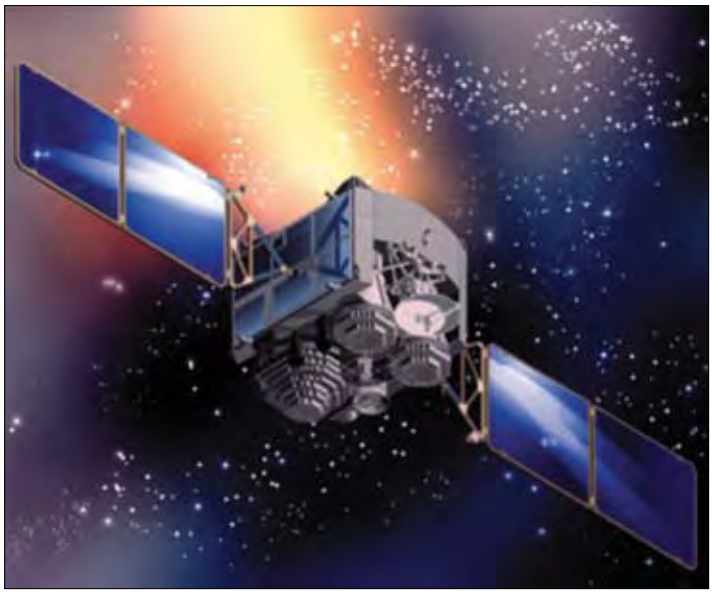
- Positioning, Navigation, and Timing
- Environmental Monitoring
- Intelligence, Surveillance, and Reconnaissance
- Communications
- Command and Control

The Military Satellite Communications (MILSATCOM) Joint Program Office (MJPO) has taken on the challenge to provide the space communications systems required to support our national security efforts and the joint warfighter. Space communication systems were viewed as an integral part of achieving Information Superiority defined in *Joint Vision 2010* as "the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same." *Joint Vision 2020* expands further on the importance of space contributions to battlefield communication as the continued development and proliferation of information technologies make information superiority "a key enabler of the transformation of the operational capabilities of the joint force and the evolution of joint command and control."

The MJPO's primary mission is to support the President, Secretary of Defense, and combat forces of all Services with survivable, worldwide, rapid communications for all levels of conflict. The MJPO acquires major system segments including space, mission and satellite control, and Air Force terminals. Together, these systems provide satellite communication capabilities in the protected and wideband frequency spectrum. Current MJPO space programs, with on-orbit assets or programmed, include the Defense Satellite Communications System (DSCS), Milstar System, Global Broadcast Service (GBS), Wideband Gapfiller Satellites (WGS), Advanced Extremely High Frequency (AEHF) System, and Transformational Satellite Communications System (TSAT).

Current Support to the Battlefield

Reports outlining lessons learned as a result of Operation Iraqi Freedom/Operation Enduring Freedom (OIF/OEF) resound with examples of SATCOM contributions to the warfighter. Former Under Secretary of the Air Force Peter Teets outlined the contributions of SATCOM to OIF in remarks at the Strategic Space 2003 Conference; "… During OIF, use of SATCOM



Defense Satellite Communications System (DSCS) satellite.

bandwidth expanded 800 percent from Desert Storm levels. Secure and jam-resistant, Milstar, used jointly by all of military services in execution of their missions, was dubbed the "work horse of the war." It was used by the Navy to direct Tomahawk cruise missiles on the opening night of hostilities; it was used to provide the daily air tasking orders to all US aircraft for the air campaign that involved well over 1000 airplanes; and both the Marines and the Army relied on it to coordinate their rapid march to Baghdad."[2]

The support provided by MJPO systems spanned all services and multiple user platforms to provide both tactical and strategic information. Four DSCS spacecraft were repositioned to optimize coverage in support of operations in Iraq. As a result of this optimization, DSCS, the backbone of MILSATCOM, carried 80 percent of all Department of Defense (DoD) satellite communications and 45 percent of all wide band communications in-theater.[3] DSCS satellites provided non-secure internet protocol router network (NIPRNET)/SECRET Internet Protocol Router Network (SIPRNET) connectivity, voice and video teleconference capability to the Combatant Commanders of CENTCOM, V Corps, 3rd Infantry Division, 1st Marine Expeditionary Force, Special Operations Command, and other deployed forces.

The Milstar medium data rate capability provided the equivalent of 32 T-1 (1.544 Mbps) data lines to the warfighter. According to Lt Col Roger Teague, former 4th Space Operations Squadron (4SOPS) commander, Milstar access was "absolutely critical" to special operations forces successes in the field. Milstar has been credited with 100 percent availability, providing support to fast moving units equipped with Secure Mobile Anti-Jam Reliable Tactical - Terminal (SMART-Ts). The 124th Signal Battalion supporting the 4th Infantry Division in Iraq managed to install, operate, and maintain the largest division communications network in the history of the Army thanks to the 14 SMART-Ts dispersed over a 90,000 square-kilometer area of operations. Minimal downtime was experienced throughout the conflict.

Milstar System satellite.

Commanders also make use of Milstar to obtain, reprogram, or update mission-target data in addition to transmitting video, facsimile, and data messages to mobile forces. The US Navy made more than 750 updates of Tomahawk cruise missile mission data packages over Milstar. Using preplanned Milstar "reachback" techniques, targeting information was sent from the US to ships at sea.

Global Broadcast Service (GBS) payload host: Ultra-high Frequency Follow-on (UFO) satellite.

The Global Broadcast System is also a big contributor to OIF/OEF providing a one-way, space-based, high-capacity broadcast system to small transportable receive suites. GBS's ability to incorporate information directly from within a theater of operations into the broadcast resulted in near real-time sharing of video and imagery data products such as those produced by unmanned aerial vehicles.

There is much anecdotal evidence that SATCOM was the only consistently reliable means of communication during OIF.[4] Due to the high mobility of our forces, and the varied terrain, LOS communication was not always possible and space provided the much needed communication functionality.

Future Support to the Battlefield

As we move to network-centric warfare, the infrastructure must be in place to provide seamless, transparent support to the warfighter. Looking toward the future, the MJPO is developing concepts for future DoD protected and wideband systems. The MJPO is also pursuing an acquisition strategy leading to the end-state vision of Internet-like secure communications with the TSAT program. In addition to providing increased bandwidth, these new systems represent a means for the transformation to network-centric warfare. Each user on the "network" will be capable of being both a consumer and provider of value-added information, thus enabling the real-time transfer of information into situation awareness and ultimately decision superiority.

Advanced Extremely High Frequency (AEHF) System satellite.

One documented complaint by the warfighter in the field is the high number of varied communication devices,[5] many providing redundant capabilities. One of our key principles at MILSATCOM is the concept of backward compatibility, delivering new capabilities to the warfighter while continuing to support legacy equipment in the field. AEHF is being designed and built to support legacy Milstar terminals in addition to the new AEHF terminals. TSAT will be backward compatible with AEHF's advanced circuit-based services (non-Milstar) providing an increase in capability without degradation of service to those units with established fielded equipment and a well-planned transition to new terminals over time.

The AEHF System is a joint service satellite communications system that will provide global, secure, protected, and jam-resistant communications for high-priority military ground, sea, and air assets. The AEHF System is the follow-on to the Milstar system, augmenting and improving on the capabilities of Milstar, and expanding the MILSATCOM architecture to enable Transformational Communications and network-centric warfare. The launch of AEHF will signal enhanced support for existing Milstar terminal users and an increase in total available bandwidth.

Additional wideband capacity will be provided with the launch of WGS Flight 1 which at that time will be the DoD's highest capacity communication satellite. WGS will augment X-band communications now provided by the DSCS and one-way Ka-band service provided by the GBS. Additionally, WGS will provide a new two-way Ka-band service. These digitally channelized, transponded satellites provide a quantum leap in communications capacity, connectivity, and flexibility for US military forces while maintaining interoperability with existing and programmed X- and Ka-band terminals. WGS will provide essential communications services for Combatant Commanders to command and control their tactical forces. Tactical forces will rely on WGS to provide high-capacity connectivity into the terrestrial portion of the Global Information Grid (GIG).

Wideband Gapfiller Satellite (WGS).

Transformational Satellite Communications System (TSAT).

During OIF, memory sticks were frequently used to transmit information from the front units due to the perception that existing network capabilities were too slow and unreliable.[6] While some units voiced concerns about multiple communication devices and the existing network performance, the challenge to provide communication capabilities to small highly

"Your space professionals are providing us our lifeline. We use it. We take it for granted; but if we ever lost it, people would die." - Lt Gen Lance Smith

mobile units remains. The GIG and TSAT will mitigate both of these concerns. TSAT's internet protocol (IP) routing will connect thousands of users through networks rather than limited point-to-point connections; the end result being a capability for the end users to operate over the network without having the communications path limiting their capabilities. This includes connectivity for disadvantaged users with small terminals, such as Battle Command on-the-move support. Additionally, TSAT will enable high data rate connections to Space and Airborne intelligence, surveillance, and reconnaissance platforms. TSAT will make use of key technology advancements where feasible to achieve a transformational leap in SATCOM capabilities. These technologies include but are not limited to: laser communications, packet switching, bulk and packet encryption/decryption, communications on-the-move antennas, dynamic bandwidth and resource allocation techniques, and protected bandwidth efficient modulation.

Conclusion

As the Nation moves towards our goal of net-centric operations and continued information superiority, MILSATCOMs are increasing in capability to meet mission needs, and will provide the warfighter the means to maximize the effectiveness of military air, land, sea, and space operations through the use of space.

Lt Gen Lance Smith, deputy commander of Central Command summed up the contribution of space systems as follows: "Your space professionals are providing us our lifeline. We use it. We take it for granted; but if we ever lost it, people would die."[7] The MJPO is dedicated to providing our Nation's warfighters that lifeline; now and in the future.

Notes:

[1] J. F. C. Fuller, *The Foundations of the Science of War* (London: Hutchington, Co. Ltd. 1925).

[2] Former Under Secretary of the Air Force Peter Teets (remarks at the Strategic Space 2003 Conference, Omaha, Nebraska, 3 September 2003).

[3] William B. Scott and Craig Covault, "High Ground Over Iraq," *Aviation Week & Space Technology,* 8 June 2003.

[4] Global Security, "Field Report, Marine Corps Systems Command Liaison Team, Central Iraq," 20-25 April 2003, http://www.globalsecurity.org/military/library/report/2003/index.html (accessed on 30 May 2006).

[5] Ibid.

[6] Ibid.

[7] Peter J. Brown, "Satellites and the Mobile Warfighter," *Satellite Today,* Military SATCOM Supplement, April 2005.

Brig Gen Ellen M. Pawlikowski (BS, Chemical Engineering, New Jersey Institute of Technology; PhD, Chemical Engineering, University of California at Berkeley) is the Director, Military Satellite Communications Joint Program Office, Space and Missile Systems Center, Los Angeles Air Force Base, California. Promoted to Brigadier General in June 2005, she directs acquisition planning, programming, budgeting, execution, and congressional activities for a $46 billion portfolio for military satellite communication systems. She exercises the authority of the Air Force Program Executive Officer for Space in interacting with the Office of the Secretary of Defense, the National Reconnaissance Office, the National Aeronautics and Space Administration, the National Security Agency, and major commands.

General Pawlikowski has served in a variety of technical management, leadership, and staff positions in the Air Force and has served as Deputy Assistant to the Secretary of Defense for Counterproliferation in OSD. Her assignment prior to the MILSATCOM Joint Program Office was the Director, Airborne Laser System Program Office, Space and Missile Systems Center, Kirtland AFB, New Mexico.

Space Warfighting Effect

The Challenges of Programming for Space Superiority

How can we afford to invest in space superiority systems? How can we afford not to?

Col Terry Djuric
Chief, Space Superiority Division,
Directorate of Programs, Office of the Deputy Chief of Staff for Strategic Plans and Programs

Walk through the door and up the steps to US Air Forces, US Central Command's (CENTAF's) Combined Air and Space Operations Center (CAOC). You are likely to see rows of computers on tables, televisions, flat screens on every wall. Look again and you will see Airmen from over 35 countries and every US service. These coalition members from varied areas of air, ground, and space expertise are working together planning, tasking, and assessing theater-wide forces; meeting air, space, and cyberspace objectives in support of the Combined Force Commander's campaign plan. You are likely to witness similar operations at the Hardened Tactical Air Control Center in Osan AB, CAOC at Ramstein AB, Tanker Airlift Control Center at Scott AFB, or at the 1st Air Force CAOC for Joint Task Force Katrina and Rita. What you will also see is a growing role for space in each of these operations and organizations.

Space power is the ultimate force multiplier—the capability to help rescuers navigate to a stranded child in a flooded town; to assist warfighters to strike and destroy any target with an accuracy never before rivaled in the history of mankind. Effective space command and control allows us to use our resources to the fullest extent. In today's joint warfighting environment it is hard to find a military unit that does not use, directly or indirectly, space assets. There is no need to be conceited about how great space is, nor do you need to think your role of integrating space is complete. Take pride knowing what space operations bring to the fight and how we owe our citizens, our fellow warfighters, to continue improving space integration.

How do we program years in advance to assure warfighters are equipped to execute a campaign plan and fully integrate the best space capabilities? How can you better support the critical role of programming to enable space superiority? I have been a space operator and worked in the Joint Space Operations Center (formerly Space AOC). I have coordinated space integration in the Pacific Command (PACOM) and Central Command (CENTCOM) areas of responsibility (AORs) for operational plans and real-time execution. More recently, I deployed to the CENTAF CAOC as Director for Space Forces (DIRSPACEFOR or DS4) responsible for assisting the Combined Force Air Component Commander (CFACC) in Space coordinating authority in Operation Enduring Freedom (OEF), Operation Iraqi Freedom (OIF) and operations around the Horn of Africa. Over the past year, I have experienced the process of getting Air Force programs funded through the Air Staff's Corporate Structure, Office of Secretary Defense's (OSD's) Program & Budget Review, and approved by Congress. For some programming perspective, let's start with a quick glance back to World War II.

Maybe you have seen documentaries or read books describing the Dowding System used during the Battle of Britain. The Dowding System is often referenced as the first integrated air defense system and accredited with the flexibility to redirect air assets to patrol or intercept incoming raids with an overwhelming 80 percent success rate.[1] This success story combined air forces from 16 countries into a complex system of command and control with limited radar, short range radios, and volunteer observers. After the beginning of the Battle of Britain, the United Kingdom's Ministry of Defence authorized the Royal Air Force to procure and integrate improved communications with the adoption of very high frequency radio sets. The astounding results of the Battle of Britain demonstrate the value of centralized air control with flexibility to reprogram defense department funds for urgent warfighter needs. The process of command and control of airspace has improved with every military campaign since its inception in World War II. In fact, the United States Air Force Air and Space Operations Center (AOC) has matured into a flexible system capable of planning and executing a major theater air campaign or sustaining air and space superiority for peacemaking or counterinsurgency operations as in OEF and OIF.

So how would this process of programming for modernized systems look today in the United States? The term "programming" in this context is the period when planning decisions, programming guidance, and congressional guidance are converted into a detailed allocation of resources. The services and agencies match their available resources against Department of Defense validated requirements and submit program proposals. To accomplish this we use the Planning, Programming, Budgeting, and Execution (PPBE) system.[2] As an example, we will review the PPBE steps used during the FY 2007-11 amended program objective memorandum (APOM) to request a $15.6 million Near Space enhancement and how those same programming steps are in progress as we build the FY 2008-13 program objective memorandum (POM).

For Headquarters Air Force, the programming process begins each year when the major commands (MAJCOMs) bring their proposals forward in April and continues when we submit our Change Proposals to OSD in August. So how did this work for our Near Space example? In April 2005, Commander, Air Force Space Command recommended an addition to the operationally

responsive space program in FY 2007-11 for a Near Space program. The $90.5 million add would fund two 2-week demonstration deployments of balloon/payload return capability, establish an acquisition office for Near Space efforts, lease an airship for demonstration of loiter capability, and procure future Near Space equipment. In May 2005, the Acting Secretary of the Air Force (SECAF) and Chief of Staff of the Air Force (CSAF) agreed the Near Space demonstration was a special interest item, but only agreed to the FY 2007 funds, $15.6 million. The Acting SECAF and CSAF preferred to demonstrate the capability in FY 2007. If successful, the Air Force would program for the capability in future years. Since we had thumbs up from the Acting SECAF and CSAF, it was up to the Air Force Corporate Structure to determine the offsets to balance this enhancement. Throughout May, June, and July, members of the Air Force Group and Air Force Board discuss hundreds of adjustments similar to our Near Space example. We work with MAJCOMs during those months to assess and validate each enhancement and offset presented in April. In July, the Air Force Corporate Structure recommends a balanced budget to the SECAF who submits this to OSD in August. Back to our Near Space example, in August 2005, the Air Force submitted eight change proposals grouped by capabilities for the FY 2007-11 APOM. The Near Space enhancement was included in the Space Superiority Change Proposal.

Next in the PPBE process comes OSD's program/budget review (PBR) in September that concludes in December with program decision memorandums (PDM) and program budget decisions (PBD). Anyone involved in OSD's Program Review should get refresher training in hostile negotiations as those that typically prevail are the ones keeping a cool head and persevering with the Air Force message (in fact, Air Force programmers actually receive this training!). So how did Near Space fair during PBR? Initially, the Air Force had a bumpy ride when we asked OSD to create a new program element (PE) for Near Space separate from operationally responsive space. We were encouraged by OSD to first demonstrate the capability and then create the PE. Then we spent a few weeks discussing Near Space (aka High Altitude Long Loiter [HALL]) in the Quadrennial Defense Review (QDR). Eventually, QDR members were asked to review the Air Force's space superiority change proposal, which was accepted as written. The 2005 PDM III implemented the decision to add $15.6 million in FY 2007 for Near Space capability.

So we have described nine months of the PPBE process. What does the Air Staff do January, February, and March? We mockingly refer to January through March as our "down time." However, this time is anything but slow. January is the month to work with MAJCOMs, field operating agencies, and direct report units to answer questions, interpret the previous year's program decisions, and publish the next year's Annual Planning and Programming Guidance. In February, the Presidents' Budget is delivered to Congress for review. The Air Force hosts congressional staffer briefs in February and March to discuss budget change proposals. This year, no issues were noted with regards to the FY 2007 Near Space enhancements. In fact, in past years Congress has favorably "marked" (increased the funding) of operationally responsive space for tactical satellite research and development so the Air Force has an optimistic outlook for Near Space funding being supported. We expect to hear results of the FY 2007-11 appropriations and authorization bills for the defense budget in August 2006.

Let's shift back to building the FY 2008-13 program objective memorandum or "08 POM." Successfully planning Air Force programs in an ever-shrinking defense budget arena requires strategy, skill, and a consistent Air Force message. This is extremely important as we begin building the 08 POM. The Air Force lost $2 billion in buying power—a result of the FY 2005 base realignment and closure, FY 2006 QDR, and FY 2007-11 APOM. The results of this are a current lack of resources to fund all our required capabilities, as well as, and keen competition within the service for the Air Forces's $120 billion in total obligation authority (TOA). Over the next three months, through the halls of the Pentagon, the Air Force will aggressively review every program and determine how we meet the SECAF and CSAF priorities to recapitalize, modernize, and transform our air, space, and cyberspace systems. If you have ever tried to find an office in the Pentagon you know how difficult it can be navigating in this labyrinth. Programs face similar obstacles in getting through the Pentagon hallways and transitioning from PowerPoint slides to real programs.

Let's finish with a question posed during our original World War III vignette. What if there is a need for a program and we do not have the time to go through the rigors of normal programming? How do we, as Headquarters Air Force, make the necessary adjustments to cover this? With our forces engaged in the Global War on Terrorism, working outside of the "normal" POM process is a critical part of our job here on the Air Staff. The CSAF can give us planning guidance in the form of a special interest item. We can work to get that system on an accelerated development schedule and mock-deploy it to a testing site in the continental United States for a demonstration of its capabilities. Should the demonstration succeed, fielding of the system and inclusion into the POM will follow. Warfighter urgent need requests can come in from the field and these are also handled outside the POM. Take, for example, the need for the field to possess a better communications relay. Near Space systems operate in an emerging medium—flying at extremely high altitudes, but lower than what we typically consider space proper. Communications systems in Near Space could be just what the warrior is looking for. Whatever capability (air, space, or cyberspace) is determined to meet the warfighter's desired effect, there are processes in place to ensure these systems are delivered in the most expeditious manner possible. If a space-related capability is offered to meet a theater need a key element to seeing space systems deployed goes back to my roots as DIRSPACEFOR—making sure these systems are coordinated with the CFACC! For example, the $15.6 million funds in FY 2007, how does the Air Force plan and execute the Near Space demonstration? We will leave these details up to Air Force Space Command and the theater commands. However, I am confident if a deployment is planned to the CENTCOM AOR, that the DIRSPACEFOR will assist the CFACC in coordinating this effort. Since we are only months away from FY 2007, keeping the DIRSPACEFOR informed of the progress of Near Space funds will help assure the CFACC (the delegated Space coordination authority for the CENTCOM AOR) and CAOC leadership is

informed to work deployment orders.

While much of this article is informative in nature, I would like to end with a call to action, a challenge, for all involved in space programs to search and find ways to improve their contribution. As the signs say throughout the corridors in the Pentagon, "We are at war, are you doing all that you can do?" America continues to forge her place in history with our domination of the skies. What we do today sets the stage for tomorrow and gives an edge to whoever will claim their place in the annals of history as masters of air *and* space. Contracting officers, program managers, scientists, engineers, everyone involved in these programs from the current execution year financial managers to the out-years strategic planners I ask you again, from the most junior Airman to the highest levels of leadership, "We are at war, are you doing all you can do?"

Contributing author, Maj Matt Whiat, Space and Missile Force Programmer, Space Superiority Division, Directorate of Programs, Office of the Deputy Chief of Staff for Strategic Plans and Programs.

Notes:

[1] *Wikipedia*, "Battle of Britain," http://en.wikipedia.org/wiki/Battle_of_Britain (accessed 19 February 2006).

[2] OSD Comptroller, iCenter, "Planning, Programming, Budgeting, and Execution System," http://www.dod.mil/comptroller/icenter/budget/ppbsint.htm (accessed 26 February 2006).

Col Terry Djuric (BS, Computer Science and Information, Mary Washington College, Virginia; MA, Curriculum and Instruction, University of Colorado, Colorado Springs; MS, Strategic Studies, US Army War College, Pennsylvania) is the Chief, Space Superiority Division, Directorate of Programs, Office of the Deputy Chief of Staff for Strategic Plans and Programs, Headquarters US Air Force, Washington, DC. The Directorate of Programs integrates, evaluates and analyzes the US Air Force Future Years Defense Program.

Colonel Djuric was a distinguished graduate in 1983 from Officer Training School. She has operated space systems at North American Aerospace Defense Command; 5th Space Warning Squadron, Woomera, Australia; 21st Space Wing, Peterson AFB, Colorado; and the 614th Space Operations Squadron, Vandenberg AFB, California. She has commanded a space operations squadron and operations group. Her experience in space systems includes strategic and theater missile warning, space control, and command and control of aerospace systems. Colonel Djuric's staff assignments include: Squadron Officer School, Air Force Personnel Center, United States Pacific Command, and United States Strategic Command. She was also the first Director for Space Forces at Al Udeid AB, Qatar.

Maj Matt Whiat (BS, Industrial Engineering Tech, Southern Illinois U; MS, International Relations, Troy U, Alabama; MS, Business Management, Troy U, MS Finance, Air Force Institute of Technology, Ohio) is a Space and Missile Force Programmer in the Space Superiority Division, Directorate of Programs, Office of the Deputy Chief of Staff for Strategic Plans and Programs, Headquarters US Air Force, Washington, DC. The Directorate of Programs integrates, evaluates and analyzes the US Air Force Future Years Defense Program. Major Whiat was a C-130E/H Crew Chief during his enlisted time before graduating from Officer Training School in 1993. He has been a missile Flight Commander, an Education with Industry student, deployed with RED HORSE as a Contingency Contracting Officer; a GPS Program Manager and worked as a Military Observer for the United Nations in West Africa. Major Whiat's staff assignments include serving as the Executive Officer for the Vice Commander of Warner Robins Air Logistics Center.

Space Warfighting Effect

Blue Force Tracking: Transforming the Joint Battlefield from Space

Lt Col Scott W. Beidleman
Chief, Strategy & Concepts, "Skunk Works,"
AF/A3/5's Concept, Strategy, and Wargaming Division,
Pentagon, Washington DC

The outcomes of battles and the fates of armies have often hinged upon one's situation awareness and comprehension of the battle space.[1] In Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF), many US forces answered the question, "Who goes there?" via blue force tracking (BFT), a new capability that transformed situation awareness and led to enhanced maneuver and reduced fratricide. In fact, BFT's success in its limited wartime debut indicates the need for fuller integration of the identification technology across all forces and platforms to connect all warfighters to a common operational picture.[2] This article describes BFT capabilities, distinguishes how BFT in OEF and OIF improved situation awareness from previous wars (as manifested in enhanced maneuver and reduced fratricide), and reviews some resulting implications of BFT.[3]

Blue Force Tracking

BFT is a broad term representing a number of systems designed to locate and report the positions of friendly personnel or vehicles, and to share this information amongst all users.[4] BFT uses the global positioning system (GPS) to locate forces and transmits positional and intelligence data from "tagged" vehicles via communications satellites to data fusion centers. The fusion centers process and disseminate the information to operations centers, headquarters, and all commanders and users on the network.[5] It is a combat Intranet.

Specifically, BFT represents friendly units as blue-colored icons moving across the laptop computer screen superimposed on a map. Users can click on these icons to communicate (via text message) with any friendly unit to include Army, Marine, or British forces.[6] Enemy units, identified by various intelligence sources and entered into the system by headquarters analysts, appear as red dots.[7] Anyone with Secure Internet Protocol Router Network access to a Global Command and Control System terminal can view the situation.[8] Additionally, BFT provides separate transmission feeds for common and exclusive user visibility, crucial for special operations forces (SOF) units who may want to restrict knowledge of their whereabouts. Moreover, BFT uses geo-referenced maps, meaning users can see the location of rivers and other land features. These scaleable maps can also show the location of various hazards such as minefields.[9] Furthermore, operations centers can update their units' maps simply via file transfer. Despite these critical capabilities, prior to 9/11 the Defense Department viewed BFT systems as nothing more than a niche capability; its true potential was not realized until OEF, where demand for BFT exploded.[10]

In reaction to the demand during OEF and OIF, the US fielded as many BFT systems as possible, but still could not acquire units quickly enough to equip the whole force. In fact, roughly one in ten Army vehicles in Iraq had BFT installed.[11] Given the shortage, the systems were primarily installed in "commander's vehicles, reconnaissance vehicles, and others assumed to be in close combat with the enemy," such as tanks, Bradleys, humvees, and helicopters operated by the Army, Marine Corps, SOF, and British forces.[12] Further exacerbating BFT's scarcity on the battlefield, Turkish political constraints delayed the arrival of the 4th Infantry Division, a fully equipped BFT-capable unit, until nearly the end of hostilities. Although not optimal, the number of fielded BFT systems still revolutionized situation awareness.

Improved Situation Awareness

Prior to OEF and OIF, maintaining situation awareness was difficult and time-consuming. While US forces automatically knew their locations via GPS since Operation Desert Storm, GPS did not tell commanders the locations of the rest of their forces or other coalition forces, nor did GPS reveal enemy positions. Moreover, individual vehicles within the same unit did not automatically know each other's location. To maintain situation awareness, subordinate units had to radio their location to the command post periodically, where it was manually posted on a map board for the commander and susceptible to human error.[13] This inefficiency was further compounded when both the unit and commander were moving. Similarly, ground units followed a cumbersome, multi-step radio protocol to report encounters with the enemy.[14] Worse yet, line-of-site terrestrial radios like the Enhanced Position Location Reporting System lost effectiveness in developed urban areas (e.g., Baghdad) and mountainous regions (e.g., regions of Afghanistan), and the radios suffered from limited range, thereby constraining maneuver to certain terrain and distances. Lastly, good situation awareness for one ground commander did not instantaneously transfer to *all* ground commanders at all levels, nor to air and sea commanders. Understanding the "big picture" grew increasingly complex as one moved to the operational and strategic levels of command.

Contrast this to operations in OIF. For the first time ever, soldiers ranging from the "private driving a truck to the commanding general at [Army] headquarters in Kuwait, could watch on-screen as [US forces] moved across the battlefield."[15] US forces fought with a common operating picture; they enjoyed high fidelity, networked situation awareness. BFT clari-

fied and organized the battle space, enabling leaders at all levels to know the locations of their forces with respect to the enemy. Also, BFT provided the means for units to communicate horizontally and vertically in virtually any condition. Consequently, "BFT gave commanders situational understanding that was unprecedented in any other conflict in history."[16] Two immediate payoffs of improved situation awareness were enhanced maneuver and reduced fratricide.

Enhanced Maneuver

Maneuver is defined as movement to place forces in a position of advantage over the enemy.[17] Thus, in order to move to a position of advantage, one must know one's location, the enemy's location, and contextual elements like terrain and geography. BFT leverages technology to combine GPS position accuracy, electronic mapping, and instant messaging, to amplify joint forces' ability to maneuver well beyond what was possible in previous wars. In OIF, many troops relied on BFT during the lightning-fast thrust across the desert towards Baghdad because vehicles moved so fast they outran the range of their radios and did not have the time to set up satellite communication links.[18] Without BFT, they would have been forced to regroup and travel slower. Thus, BFT enabled high-speed, cohesive maneuver. Also, as joint forces began urban warfare within Baghdad, the commander of the 3rd Infantry Division's 2nd Brigade was so confident in his ability to locate and communicate with his subordinate units via BFT that he decided to remain in downtown Baghdad upon completing his raid operations in order to retain control of key locations within the city.[19] As a result, BFT helped to limit the Iraqis' ability to mount an urban defense of Baghdad.[20]

BFT also enabled maneuver under adverse conditions. On 23 March 2003, a severe sandstorm caused zero visibility, but instead of waiting out the storm, a battalion commander decided to use the sandstorm to cover his unit's movement while conducting a search and destroy mission against Saddam's Fedayeen forces. To accomplish this maneuver "in the blind," he discarded the tools of previous wars (laminated maps and grease pencils), and relied solely on BFT. When the unit encountered an unknown obstacle, BFT allowed troops to switch from maps to imagery, which identified the obstacle as a train station, and enabled the unit to navigate safely around the unmapped structures.[21] Contrast this to Somalia in 1993 during the infamous "Blackhawk Down" episode, where a rescue convoy of US Army Rangers got lost while negotiating the streets of Mogadishu under heavy fire, struggling to find their downed comrades.[22] Had their vehicles and aircraft been equipped with BFT, the convoy drivers could have determined and shared the best route information without relying on helicopter surveillance and inefficient communications.

AL ASAD, Iraq (28 April 2005) - A massive sand storm cloud is close to enveloping a military camp as it rolls over Al Asad, Iraq, just before nightfall 27 April 2005.

Communications via instant text messaging is another aspect of BFT that enhanced maneuver. In fact, at times BFT text messaging provided the only source of communications for US Marines fighting in OEF.[23] In fact, text messaging streamlined combat. For instance, BFT featured brevity codes that allowed warfighters to send pre-defined messages quickly to update everyone on the network regarding combat engagements, supply status, injuries, and so forth.[24] Also, according to Brig Gen Robert Durbin of the 1st Calvary Division, navigating through a hostile zone in previous wars used to consume 80 percent of a soldier's time.[25] With the advent of BFT, he stated, "I've got 80 percent of my time to talk about how I'm going to kill [the enemy] instead of [locating him]."[26] While helping US forces kill the enemy, BFT also assists in keeping US forces alive.

Reduced Fratricide

Fratricide is the employment of friendly weapons with the intent to kill the enemy or destroy his facilities, which results in unintentional death or injury to friendly personnel.[27] The improved situation awareness provided by BFT in OEF and OIF helped reduce fratricide and overall casualties. Indeed, BFT capabilities alleviated four of seven root causes of fratricide, namely (1) land navigation errors, (2) known battlefield hazards, (3) reporting, crosstalk, and battle tracking failures, and (4) combat identification errors.[28] To illustrate the improvement, during Operation Desert Storm, friendly direct ground fire killed 35 soldiers, whereas in OIF, friendly direct ground fire killed only *one* soldier.[29] Additionally, near Karbala during OIF, a tank company commander planned to pass between two other friendly units at night, and move into enemy territory where he would order his tanks to "fire at will." Simultaneously and unbeknownst to him, a US scout platoon was moving into his anticipated field of fire, and before disaster struck, he saw the blue icon moving on his BFT display and changed his order.[30]

In another OIF example, a coalition fighter aircraft spotted a vehicle convoy and asked the Joint Operations Center (JOC) for permission to engage. The various liaison officers within the JOC responded that they did not expect any friendly activity within the area; however, BFT displayed "blue dots" traveling in the vicinity. The JOC contacted these forces and determined they were part of a coalition task force that had altered their route. Thus, the JOC notified the fighter pilot to disengage, avoiding a "blue-on-blue" engagement.[31]

Additionally, during the November 2001 Mazar-e-Sharif prison uprising in OEF, special operations forces (SOF) guided air strikes to suppress the revolt. Prior to calling for air support, the teams switched their BFT feeds from an exclusive SOF-only feed to a global feed, broadcasting their locations to a wider pool of network users.[32] The air operations center knew where *not* to drop bombs to avoid fratricide. However, when a ground operator passed incorrect target coordinates to the aircraft (unrelated to BFT) some friendly forces were still injured in the attack.[33] Also, most SOF aircraft losses in Afghanistan occurred with BFT systems turned off, since many covert operators were reluctant to transmit their locations over the network.[34] Thus, even with BFT, one cannot completely eliminate fratricide as one of the major frictions in war. Forces fared better in OIF, where "the incidence of fratricide fell to zero" among units even partially equipped with BFT.[35] In short, while BFT did not totally eliminate fratricide, evidence suggested it diminished the potential for friendly fire.

BFT revolutionized situation awareness during OEF and OIF with respect to previous wars, as illustrated by enhanced maneuver and reduced fratricide and casualties, resulting in significant operational effects.

In addition to reducing fratricide, BFT helped friendly forces stay alive by avoiding dangerous situations, decreasing casualties in general. For example, in northern Iraq, when a British SOF team came under direct fire from enemy forces, BFT enabled the Combined Force Air Component Commander to direct recovery vehicles and fire support quickly and accurately to recover the team safely.[36] Also, a BFT locator was used to dispatch a medical evacuation helicopter into Iraq to aid a wounded soldier.[37] In another instance, base commanders using BFT observed a friendly unit traveling towards a location occupied by enemy forces and safely rerouted them to avoid contact.[38] Furthermore, BFT could be configured (by manually inputting data into the system) to steer ground units around hazards by displaying the locations of minefields and unexploded ordinance, like the cluster munitions that hindered the US Army VII Corps in Iraq in 1991.[39] As a final example, Private Jessica Lynch's unit lacked BFT capability.[40] With BFT, the unit might not have made the fateful wrong turn leading to the deaths of seven soldiers and Lynch's subsequent capture.

In summary, BFT revolutionized situation awareness during OEF and OIF with respect to previous wars, as illustrated by enhanced maneuver and reduced fratricide and casualties, resulting in significant operational effects.

Implications of Blue Force Tracking

Superior situation awareness in OEF and OIF produced positive operational and strategic effects. BFT provided US commanders with a significant advantage—a better understanding of the battle space than the enemy. The improved common operating picture enabled faster decision cycles and rapid adjustments to reality at the tactical and operational levels of war.[41] Thus, BFT shrank the observe, orient, decide, act (OODA) loop for US joint forces, enabled faster actions that disrupted the enemy's decision cycle, and created a synergy of networked forces fighting to achieve the same ends.[42]

Contrarily, poor situation awareness can have severe negative effects. In the 1991 Gulf War, Lt Gen Frederick Franks' conservative maneuver of the VII Corps during the famous "left hook" operation ultimately contributed to the Republican Guard's escape. Without a common operating picture, Franks and General Schwartzkopf interpreted Iraqi actions differently. Based on the information available to him, Franks believed the Iraqis planned to stay and fight, while Schwartzkopf knew the Iraqis were simply holding the line to support a full-scale retreat, which they successfully executed.[43] Hence, the US failed to destroy the Republican Guard and the US-led coalition did not fully achieve the strategic objective of ensuring "the security and stability of Saudi Arabia and other Persian Gulf nations."[44] Had the generals shared a common operating picture via BFT, events most likely would have unfolded differently.

Using BFT today, senior commanders in the JOC and the Pentagon share the same information with commanders in the field. As previously discussed, BFT enabled the "race" to Baghdad during OIF. Using the BFT "big picture," US commanders maintained a cohesive, rapid maneuver and synchronized actions across the force, allowing US forces to surprise and paralyze Iraqi forces. An Iraqi Army general's words epitomize the effect of a smashed OODA loop, "… the tank assault was so fast and sudden … I think I'm still in a state of shock."[45] Hence, BFT served as a significant force multiplier and "OODA loop destroyer" that contributed to the quick collapse of the Iraqi regime.

Additionally, since BFT utilized space-based assets for navigation and communication, its range effectively provided command and control over large distances during OEF and OIF.[46] For instance, the 3rd Infantry Division "controlled two major battles over 200-230 kilometers."[47] In previous wars, span of control was limited to 30 kilometers.[48] In fact, in OEF, one brigade task force controlled an area as big as Texas.[49] Thus BFT enabled economy of force on a grand scale. In addition to these operational effects related to maneuver, BFT also influenced strategic outcomes through reduced casualties and fratricide.

Since the Vietnam War, American decision makers' sensitivity to casualties has shaped the application of American military force.[50] Some adversaries believe if the US suffers heavy casualties, America may change its policy due to loss of domestic support. Thus, US aversion to casualties is a center of gravity, and exploiting it has become a counter-coercion strategy.[51] Saddam Hussein hoped to exploit this strategy in the 1991 Gulf War and failed, but the unexpectedly low American death toll in Desert Storm further solidified the US standard for bloodless foreign policy in the future.[52] Later, Somali warlord Mohammad Farrah Aideed applied the strategy and succeeded, proving that he could "get rid of Americans by killing them so

that public opinion will put an end to things."[53] Hence, BFT has strategic implications as a tool to help defeat the counter-coercion strategy that attempts to generate US casualties.

In addition to casualties in general, fratricide has grown in importance, and may undermine coalition support, domestic support, and combat effectiveness. Fratricide has steadily increased as a percentage of overall casualties, rising from ten percent in World War I to 24 percent in Desert Storm, mainly because overall casualties have dropped.[54] Consequently, a substantial share of US casualties is self-inflicted, elevating the impact of fratricide to the strategic level, especially when the victims are allies. For instance, in OEF an American F-16 bombed a Canadian light infantry company conducting a nighttime live-fire exercise, killing four soldiers and injuring eight others. The Canadian public responded with "… an immediate and prolonged outcry to withdraw Canadian troops from Afghanistan."[55] Furthermore, the incident most likely contributed to Canada's decision to remove the Princess Patricia's Light Infantry units earlier than planned.[56] Additionally, in the first 18 days of OIF, British troops suffered the most fratricidal deaths of any coalition member, and actually endured more deaths from coalition fire than from Iraqi fire.[57] These US-on-British deaths undermine the British soldier's confidence in US air support in the short term, and may have long-term effects on the professional military relationships between Britain and the US.[58]

In this modern age of technology, the US public does not expect fratricide to occur at all and finds it hard to accept the losses when they do occur.

In addition to hurting coalition support, fratricide may damage US domestic support. In this modern age of technology, the US public does not expect fratricide to occur at all and finds it hard to accept the losses when they *do* occur.[59] Furthermore, the news media may sensationalize incidents such that an "ill-informed public reacts with distrust," and demands retribution or "… investigations … which cannot be provided with any degree of speed or accuracy and thus often lead to unwarranted charges of cover-up and malfeasance" on the part of the government.[60]

Besides complicating domestic support, fratricide degrades combat effectiveness. In the US Civil War, some believe the impact of Stonewall Jackson's fratricidal death disturbed General Robert E. Lee to the extent that it caused him to lose the battle of Gettysburg, and influenced the outcome of the war.[61] Moreover, based on studies of fratricide, the Center for Army Lessons Learned asserts that fratricide degrades combat effectiveness by causing loss of initiative, low confidence in unit leadership, eroded morale, and failure to use supporting combat systems (air support),[62] to name just a few. Additionally, weapons aimed at friends are not aimed at the enemy, and friends killed by friends cannot fight the enemy, resulting in loss of combat power.[63] These compounding effects have cumulative consequences, as ineffective tactical operations beget ineffective results at the operational and strategic levels. Accordingly, BFT's potential to reduce fratricide contributes to retaining combat effectiveness as well as coalition and domestic support.

While BFT revolutionized situation awareness in OEF and OIF, the revolution has not reached everyone. Although only one soldier was killed by direct ground fire in the major combat phase of OIF, many more were killed by air-to-ground mishaps because, in part, most aircraft were not integrated with the BFT-enhanced ground picture, or their BFT systems were not interoperable. As a next step in building battlefield situation awareness, the Air Force should address existing shortcomings (such as interoperability, and latency issues, i.e., delays in information transmission and receipt) that might inhibit fusing BFT systems with Airborne Warning and Control System, Joint Surveillance Target Attack Radar System, and other air and space command and control capabilities, with the intent to create persistent, accurate situation awareness.

In conclusion, BFT transformed situation awareness by decreasing the unknowns in the battle space beyond anything experienced in previous wars. Today's BFT-equipped warriors at the tactical and operational levels have immediate access to the bigger picture. Furthermore, superior situation awareness enhanced maneuver and contributed to reduced fratricide and overall casualties, each with significant implications. Finally, the Air Force should build on BFT's success by fully integrating the technology across all platforms, ensuring joint forces fight on the same page … or laptop screen. Then the joint warriors of the 21st century will no longer have to wonder, "Who goes there?" They just glance at their BFT screens and press on.

Notes:

[1] Richard J. Dunn III, "Blue Force Tracking: The Afghanistan and Iraq Experience and Its Implications for the US Army," Northrop Grumman Mission Systems, 2003, http://www.analysiscenter.northropgrumman.com/files/BFT-WP%20Halfc.pdf (accessed 22 May 2006).

[2] Third Infantry Division (Mechanized) After Action Report: Operation Iraqi Freedom, July 2003, 52, http://www.carson.army.mil/Moblas/NBC/3rdIDAARIraqJuly03.pdf (22 May 2006).

[3] For the purposes of this article, BFT refers primarily to the Force XXI Battle Command Brigade and Below, the Grenadier BRAT, and the MTX systems.

[4] The system can also report the locations of enemy forces, but tracking enemies is not an automatic feature. It requires continuous, manual input of red data by intelligence personnel.

[5] During OEF and OIF, the network was managed by the Army at Camp Doha, Kuwait, and by the Mission Management Center in Colorado.

[6] Anthony H. Cordesman, "The Lessons of the Iraq War: Main Report," Center for Strategic and International Studies, 11th draft, 21 July 2003, 186, http://www.csis.org/media/csis/pubs/iraq_instantlessons.pdf (accessed on 22 May 2006).

[7] Vernon Loeb, "Digitized Battlefield Puts Friend and Foe in Sight," *Washington Post*, 3 March 2003, final edition.

[8] Maj Mark Shaaber et al., "V Corps: C4ISR Integration After Action Report," May 2003, 11.

[9] Battlefield hazards are illustrated via imagery overlay or manually inputted similar to red force data.

[10] Adam Velie, "Booz Allen Hamilton & Blue Force Tracking: A Successful Partnership," 2003.

[11] Dr. Bruce Robinson, "Who Goes There?," IEEE Spectrum Online, 11 October 2003, http://www.spectrum.ieee.org/WEBONLY/publicfeature/oct03/mili.html (accessed 16 May 2006, requires IEEE Xplore membership).

[12] Matthew French, "Generals Point Ways to Better Blue Force Tracking," *Federal Computer Week*, 21 October 2003, http://www.fcw.com/article81257-10-21-03-Web (accessed 22 May 2006).

[13] Dunn, "Blue Force Tracking," 3.

[14] Frank Tiboni, "Force XXI Proves Mettle by Saving Lives in Iraq," *Defense News*, 9 June 2003, 15.

[15] Robinson, "Who Goes There?"

[16] Third Infantry Division (Mechanized) After Action Report, 52.

[17] Joint Publication (JP) 1-02, DOD Dictionary of Military Terms, 318, http://www.dtic.mil/doctrine/jel/new_pubs/jp1_02.pdf (accessed on 22 May 2006).

[18] Robinson, "Who Goes There?"

[19] Loren Thompson, "Three Systems Will Tell Tale of Transformation," *Defense News*, 13 October 2003.

[20] Ibid.

[21] Lt Col John W. Charlton, "Digital Battle Command Baptism by Fire," *Armor*, November-December 2003, 28, http://www.knox.army.mil/armormag/CameronIndex/6charlton03.pdf (accessed on 22 May 2006).

[22] In reference to Mark Bowden's book, *Black Hawk Down: A Story of Modern War* (New York, NY: Atlantic Monthly Press, 1999), which chronicled the plight of Task Force Ranger on 3 October 1993 where 18 US soldiers died during a raid to capture senior lieutenants of Somali warlord Mohamed Aideed.

[23] Maryann Lawlor, "Keeping Track of the Blue Force," *Signal Magazine*, July 2003, http://www.afcea.org/signal/articles/anmviewer.asp?a=127&z=57 (accessed on 22 May 2003).

[24] Maj Thomas McCarthy, special operations helicopter pilot (MH-53), interviewed by the author, 31 Oct 2003.

[25] T. Trent Gegax, "Wired for Battle," *Newsweek*, 3 March 2003, 32.

[26] Ibid.

[27] Larry Kulsrud, "Fratricide: Reducing Self-Inflicted Losses," US Army Combat Readiness Center, 4 April 2005, https://crc.army.mil/Guidance/detail.asp?iData=160&iCat=120&iChannel=15&nChannel=Guidance (accessed on 22 May 2006). JP 1-02, the DoD Dictionary of Military and Associated Terms, does not define fratricide but defines "friendly fire" as "a casualty circumstance applicable to persons killed in action or wounded in action mistakenly or accidentally by friendly forces actively engaged with the enemy, who are directing fire at a hostile force or what is thought to be a hostile force."

[28] Ralph D. Nichols, "Avoid the Blues," Center for Army Lessons Learned, http://www.defesanet.com.br/docs/AvoidtheBlues.pdf.

[29] Dunn, "Blue Force Tracking," 11.

[30] Robinson, "Who Goes There?"

[31] Lt Col Todd Freece, interviewed by the author, 28 October 03.

[32] Maj Mitchell Ackerman, interviewed by the author, 16 October 2003.

[33] Jonathan Marcus, "Analysis: Friendly Fire Danger," *BBC News*, 18 April 2002, http://news.bbc.co.uk/1/hi/world/americas/1937217.stm (accessed 22 May 2006).

[34] Ackerman, Interview.

[35] Robinson, "Who Goes There?"

[36] Capt William Woolf, interviewed by the author, 20 October 03.

[37] Ms. Deirdre Lee, "Hearing on Federal Procurement Policy: Is the Federal Government Failing Certain Industrial Sectors?," Testimony of the Director, Defense Procurement and Acquisition Policy Office of the Undersecretary of Defense for Acquisition, Technology and Logistics, before the house of Representatives committee on Small Business, 22 July 2003, http://wwwc.house.gov/smbiz/hearings/108th/2003/030722/lee.asp (accessed on 22 May 2006).

[38] Dan Caterinicchia, "Soldiers Clamor for Tracking System," *Federal Computer Week*, 4 April 2003, http://www.fcw.com/article81722-04-03-03-Web (accessed on 22 May 2006).

[39] Michael R. Gordon and Bernard E. Trainor, *The General's War*, (Boston, MA: Little, Brown and Co., 1995), 381.

[40] Thompson, "Three Systems Will Tell Tale."

[41] Bill Gertz and Rowan Scarborough, "Inside the Ring," 5 September 2003, http://www.gertzfile.com/gertzfile/ring090503.html (accessed on 22 May 2006).

[42] OODA is an acronym referring to John Boyd's decision model, "observe, orient, decide, act."

[43] Gordon and Trainor, *The General's War*, 397.

[44] GAO, NSIAD 97-134, Operation Desert Storm: Evaluation of the Air Campaign, July 1997, http://www.fas.org/man/gao/nsiad97134/app_05.htm (accessed on 22 May 2006).

[45] David Zucchino, "Iraq's Swift Defeat Blamed on Leaders," *Los Angeles Times*, 11 August 2003, home edition.

[46] Dunn, "Blue Force Tracking," 12.

[47] Ibid., 12.

[48] Ibid., 9.

[49] Ibid., 12.

[50] Daniel Byman and Matthew Waxman, "Defeating US Coercion," *Survival* 41, no. 2 (Summer 1999): 109.

[51] Daniel Byman and Matthew Waxman, "Kosovo and the Great Airpower Debate," *International Security* 24, no. 4 (Spring 2000): 32.

[52] Byman, "Defeating US Coercion," 109.

[53] Byman, "Kosovo and the Great Airpower Debate," 32.

[54] Kulsrud, "Fratricide: Reducing Self-Inflicted Losses."

[55] Frank Morgret, "Friendly Fire Kills Allies and Support," *Naval Institute Proceedings*, August 2002, 86.

[56] Ibid., 86.

[57] Anthony Swofford, "Friend and Foe," *Guardian Unlimited*, 8 April 2003, http://www.guardian.co.uk/print/0,3858,4643063-103550,00.html (accessed on 23 May 2006).

[58] Ibid.

[59] LCDR William Ayers, III, "Fratricide: Can it be Stopped?," 1993, http://www.globalsecurity.org/military/library/report/1993/AWH.htm (accessed 23 May 2006).

[60] Charles R. Shrader, "Friendly Fire: The Inevitable Price," *Parameters*, Autumn 1992, 41.

[61] Ayers, "Fratricide: Can it be Stopped?"

[62] Nichols, "Avoid the Blues."

[63] US Congress, Office of Technology Assessment, *Who Goes There: Friend or Foe?*, OTA-ISC-537 (Washington DC, US Government Printing Office, June 1993), 1.

Lt Col Scott W. Beidleman (BS, Penn State University; MEng, University of Colorado) is the Chief, Strategy and Concepts, assigned to the "Skunk Works," the AF/A3/5's Concept, Strategy, and Wargaming Division, Pentagon, Washington DC. The mission of the "Skunks" is to serve as the Air Staff's operational strategy think tank, advocating the proper role for air and space power worldwide. It serves as the critical operator voice linking Air Force operating concepts to Air Force strategy, plans, and programming functions.

Lieutenant Colonel Beidleman's operational experience includes tours with the 21st Space Wing and the 50th Space Wing, in GPS satellite operations, space surveillance and space control systems, including duties as Chief of Stan/Eval and Operations Officer. In addition to his Air Staff experience, he served on a combined headquarters staff with Multi-National Force–Iraq at the US Embassy, Baghdad, Iraq, as a Coalition planner in Operation Iraqi Freedom. He will take command of the 533rd Training Squadron at Vandenberg AFB, California, in July 2006. Lieutenant Colonel Beidleman is a graduate of Squadron Officer School, a distinguished graduate of Air Command and Staff College, and the USAF School of Advanced Air and Space Studies (SAASS).

Distributed Mission Operations for Space

Lt Col Jeffrey D. Irwin
Deputy Chief, Warfighting Integration Division,
Space Innovation & Development Center

There is a silent pervasiveness of space technology that affects our everyday lives. The benefits of such technology are presumed to be available at all times, almost akin to those of the telephone system and municipal utilities. Acquisition, sustainment, and day-to-day operation of systems such as the global positioning system (GPS), communication relays, and weather satellites are taken as routine. Although born of military necessity, such complex space technologies are at the very heart of commonplace capabilities provided by OnStar®, cellular telephones, and automobile navigation systems. One only has to take note of the commotion surrounding the 19 May 1998 failure of a single commercial communications satellite (PanAmSat's Galaxy IV spacecraft control processor failure resulted in loss of service to 90 percent of the 45 million pagers in the US and to some television, radio, and retail store networks) to realize the extent to which we as a Nation have become reliant upon space assets and capabilities.[1]

Our adversaries recognize full well the reliance on the true high ground that the United States public and military has attained and enjoys with mastery of the space realm. They are quick to learn its strengths, weaknesses, and vulnerabilities, and are endeavoring to match, to exceed, or alternatively, to find ways to defeat our capabilities. Indeed, in this era any country can be a "space faring" nation for a price, and many are doing just that—purchasing space launch services, technologies, or products from those willing to sell such wares and services in an effort to counter US space capabilities.[2]

Air Force Space Command (AFSPC) is, in a very real sense, at the same crossroads pioneers such as Giulio Douhet and his contemporaries faced when air was weaning itself from being a mere curiosity and occasional reconnaissance asset to being a true medium of warfare.[3] Personnel in more established military realms typically see space systems and products in much the same light as does the civil sector—an "always there" novelty and adjunct capability, often viewed as merely a means looking for an end. They are most comfortable with what they consider tried, true, and trusted traditional methods for obtaining necessary warfighter information. This is not to point fingers at or to place blame on those with such a mindset. Typically the warfighter's only exposure to space capabilities is during training exercises when the benefits and effects of space are "white carded" as an artificial scripted input versus being presented in a realistic fashion. While such an exercise inject may state that "GPS is down," the players know their location full well and the space inject is merely "noted."

Air Operations Center (AOC).

It is clear that the time has come to bring space training fidelity up to par with that of more established systems—for both space system operators and for those who are users of the effects provided by space systems. Many satellite operations squadrons train personnel using proprietary, stand-alone systems built by the prime satellite contractor. While such systems are sufficient for training aspects of a specific system, they fall short of what is required to truly integrate the capabilities and effects of space systems into the type of warfighter training and execution needed today. The air community faced this stand-alone trainer problem in the 1990s when it transitioned from part-task trainers to distributed mission trainers—allowing pilots to train interactively with other aircraft and other military entities.[4] A set of Institute of Electrical and Electronics Engineers (IEEE) distributed interactive simulation (DIS) standards evolved out of this effort in 1995—detailing the network protocols to be used to allow such simulators to interact. Some challenges presented by the DIS standard resulted in the development of the related, yet less pervasive High Level Architecture (HLA), which also has an associated IEEE standard. Most simulators built today are able to communicate via either DIS or HLA standard protocols.

Military training exercises and experiments explore application of ever-evolving tactics and capabilities to train 21st century warfighters. Prior to the advent of distributed mission trainers and DIS, exercises were conducted live on test and air ranges provided by the likes of the Edwards AFB, California; Eglin AFB, Florida and Nellis AFB, Nevada ranges. Such ranges have very real limitations ranging from ordnance areas to frequency spectrum considerations to noise abatement concerns. A scheduled training event may be ready to go, only to be scrapped on exercise day due to bad weather conditions or aircraft maintenance issues. In the words of former Air Force Chief of Staff, General John P. Jumper, retired, "The lines between tactical and

operational levels of war are becoming blurred. We operate together in a complex cycle involving [intelligence, surveillance, and reconnaissance] ISR, communications nodes, mobility systems, and combat aircraft. This just doesn't come together on its own—we must train for that fusion of assets. This is where [distributed mission operations] DMO comes in."[5]

The value of distributed mission training for mission rehearsal and realistic interactive, immersive scenarios became readily apparent shortly after its introduction—not only for the training value, but also for the very real cost savings in travel, jet fuel, range time, and aircraft maintenance. Training in this virtual environment also allowed experimentation with tactics not permissible in the peacetime live training environment, as many of the constraints of live ranges did not apply to the virtual world.

For the flying community, a major hub of this activity developed at the former Theater Aerospace Command and Control Simulation Facility (TACCSF) at Kirtland AFB, New Mexico. From this facility, communication lines were established to link the disparate training locations, allowing pilots to literally climb into the distributed mission trainers at their local unit and participate in nationwide and globally-distributed simulation exercise events. The Army and Navy were also on board—with representations of their systems present as entities in the distributed interactive simulation protocol, visible to pilots and others alike during exercise events. General Jumper, retired, is a strong advocate of distributed mission training—so much so that on 12 March 2004, he directed the TACCSF be renamed the Air Force Distributed Mission Operations Center of Excellence, known as the DMOC. The former name implied an exclusive focus on command and control, versus the necessarily broader scope of distributed mission operations and training.

In the space realm, it becomes increasingly difficult to realistically train against potential adversary tactics when the civil and military world is simultaneously dependent on those very systems and effects we desire to exploit. The same benefits the air community enjoys via distributed mission simulation could be leveraged by the space community in the virtual, distributed mission training environment. General Lance W. Lord, retired, former AFSPC Commander, underscored the importance of this venue for space exercises in a December 2004 memorandum naming the Space Warfare Center (since redesignated the Space Innovation and Development Center, SIDC) the Distributed Mission Operations Center for Space (DMOC-S). General Lord, retired, stated, "A space command and control integrated training system is required to provide a virtual, global, synthetic battlefield in which space forces—fully integrated with other US and allied forces—will be able to train and rehearse missions in a way which will provide predictive confidence in our capabilities to support national defense and deter potential enemies."[6]

The time is right to establish a space counterpart for Kirtland AFB's DMOC. The DMOC-S is physically located in the SIDC Warfighting Integration Division at Schriever AFB, Colorado. The facility has a longstanding relationship with the DMOC and has supported Air Force and Joint exercises for many years as the Space Applications and Integration Facility, providing space inputs to exercise venues primarily in the areas of combat search and rescue, blue force tracking, and theater missile defense. Network technology has improved dramatically since the early distributed simulation days—DMOC-S now leverages high-bandwidth communications via the Defense Research and Engineering Network and the Joint Training and Experimentation Network for joint exercise play. Technical issues surrounding multi-level security are also very manageable with modern technology, allowing participants from disparate classification levels to participate in a given exercise while appropriately safeguarding sensitive information.

A major step forward in integrated training is to take space from being merely an input or "inject" during exercises to providing value-added training to the participating space operators. This "two-way flow" of information and training value is one of the tenets adopted by the distributed mission training community—namely, that no exercise participant should be used solely as a training aid for others. With that end in mind, the DMOC-S is working to develop the capability to first represent a broader range of space systems and effects in exercises from the Schriever AFB facility, and secondly to place such representation in the hands of actual operators at the various squadrons operating each system. In the event a given squadron is unable to support an exercise, the DMOC-S could then emulate their participation so the broader training audience is unaffected. Such training systems are the space community's version of the flying world's distributed mission trainer, residing on or near the operations floor of each squadron operating the various space constellations.

A promising early development in space distributed mission training was conducted with operators from the 2nd Space Warning Squadron (2 SWS) at Buckley AFB, Colorado. Two operators from the 2 SWS participated in the VIRTUAL FLAG 05-1 exercise from the Northrop-Grumman contractor facility in Azusa, California, using an experimental, contractor-developed distributed training system. The operators were extremely impressed with the training value obtained through interactive

DMOC-S personnel performing network and simulator configuration tests prior to VIRTUAL FLAG. Pictured from left are: Reggie Spivey, Herb Hipple, Darlene Boyd, and Major Jim Robertson.

participation in the virtual exercise event on consoles nearly identical to those used in daily operations at their home station. In April 2006, the SIDC Warfighting Integration Division contracted with Northrop-Grumman to bring the training system online first at DMOC-S and then at Buckley AFB, so the 2 SWS operators can routinely obtain interactive training during exercises literally "in their backyard." In the event the 2 SWS mission precludes participation in an exercise event, the DMOC-S will represent them with constructive simulation via the comparable system located at their facility.

The SIDC's 595th Space Group and Warfighting Integration Division are working together with Headquarters AFSPC, the Fourteenth Air Force Joint Space Operations Center, and the 50th, 21st, and 460th Space Wings to establish a SPACE FLAG event that will ultimately grow to leverage this exciting training technology and continue the momentum to increase interactive exercise participation by the space community. There are hardware implications at each space operations squadron to transition from the current, predominantly stand-alone operator consoles to those able to communicate via DIS or HLA protocols on virtual networks. SIDC DMOC-S personnel, in conjunction with Mr. Paul Eckert of the Space Training Acquisition Office, are working to find effective ways to develop and implement these space operations distributed mission trainers. After the necessary hardware and infrastructure is in place, the methodology of distributed training exercise events will require socialization among space operations squadrons. The intent is to springboard from the 2 SWS pilot effort, replicating the process to bring additional space operations squadrons online for DMOC-S exercise participation.

The days of the "white card inject" from space are numbered. General Jumper, retired, states, "DMO is still evolving throughout the Air Force and across the Department of Defense. Ultimately, units will be able to link together thoroughly networked training systems into a virtual battlespace and rehearse entire missions from anywhere in the world, simulating the complex threats and operating environments that they will likely face. This will cut the cost of large-scale exercises both in time and in money. We'll be able to practice complex operations rather than just independent elements, and we'll be able to incorporate our allies and coalition partners as well."[7] Training is truly the peacetime manifestation of war, and with DMOC-S, we'll be training precisely the way we fight.

Notes:

[1] M. Prado, "Emergency Satellite Rescue or Repair Services," Permanent.com, http://www.permanent.com/p-satsrv.htm. (accessed 31 May 2006); PanAmSat Corporation, "Panamsat's Galaxy VII Satellite Ceases Operations: Full-time Services Are Not Affected," press release, 24 November 2000, http://www.panamsat.com/news/pressview.asp?article=1198 (accessed 31 May 2006).

[2] Bill Gertz, "Signal Jamming a Factor in Future Wars, General Says." *The Washington Times*, 16 July 2004, http://cshink.com/signal_jamming.htm (accessed 6 July 2005); D. Kimmage, "Up in Arms Over Iraqi Arms," *Center For Defense Information Russia Weekly*, no 251, 3 April 2003, http://www.cdi.org/russia/251-9-pr.cfm (accessed 31 May 2006).

[3] Giulio Douhet, *The Command of the Air* (New York: Arno Press, 1972).

[4] Warfighter Readiness Research Division, Air Force Research Laboratory, "Distributed Mission Operations Research Technology and Methods."

[5] *DMO: The Warfighter's New Edge*, DVD, HQ USAF Television Center, 2005.

[6] General Lance W. Lord, retired, Commander, Air Force Space Command, to Commander, Space Warfare Center, memorandum, 28 December 2004.

[7] *DMO: The Warfighter's New Edge*.

Lt Col Jeffrey D. Irwin (BS, Aerospace Engineering, Iowa State University; MS, Management, Golden Gate University) is the Deputy Chief, Warfighting Integration Division, Space Innovation & Development Center, Schriever AFB, Colorado. He leads a division of 72 personnel that executes $12 million annually in direct support of combat operations through application and exploitation of space via the command's Distributed Mission Operations Center for Space, Aerospace Fusion Center, and Schriever Wargame Series.

Lieutenant Colonel Irwin's career includes assignments in a variety of areas to include air operational test and evaluation, distributed flight simulation, space operations and acquisition, developmental planning, and warfighting capabilities integration. Prior to his current assignment, Lieutenant Colonel Irwin led the Analysis and Test Division of the Space-Based Radar program at Space and Missile Systems Center. Lieutenant Colonel Irwin is a graduate of Squadron Officer School and Air Command and Staff College, and is completing Air War College by correspondence.

Space Warfighting Effect

SBIRS: The Continuing Evolution of Infrared Space Systems

Capt Scott W. Anderson and SMSgt Charles A. Bilbey
USAF, SBIRS Program Office
Mr. Theodor W. Polk,
Aerospace, SBIRS Program Office

The Birth of Space Based Infrared Warning

When the Soviet Union shocked the world, by launching Sputnik on 4 October 1957, it was more than just a wake-up call to the American public. The momentous event spurred the American government and national defense community into action. The implication of the 183 pound Sputnik was that our Cold War mortal enemy now had technologically moved ahead of the United States.[1]

Against this historical backdrop, the United States took decisive action. Not only did we intensify our own efforts to reach space through the Explorer program, which took a huge technological leap over the planned Vanguard program, but we also took action to provide our government with warning of hostile actions.[2] The goal was to never again be caught by surprise like we were with Sputnik. The first tentative step to providing this warning was the Missile Defense Alarm System (MiDAS) during the 1960s. This low Earth orbit, infrared satellite program included the development of twelve satellites; it was a successful first step, but did not provide the complete, continuous coverage required for effective strategic missile warning.[3] As the '70s approached, MiDAS pointed the way for a more capable program that met these needs.

On 6 November 1970, the United States Air Force launched the first Defense Support Program (DSP) satellite. It weighed about one ton, and its principal sensor was a large infrared telescope with a focal plane that used 2,000 lead-sulfide detectors. Its objective was to provide early, strategic warning of intercontinental ballistic missile (ICBM) launches.[4] Where relatively low-orbiting MiDAS had large, predictable coverage gaps, the geosynchronous DSP satellites were synoptic and have provided continuous global coverage for more than 30 years.

Defense Support Satellite (DSP).

SBIRS is a transformational program created to meet the warfighter's need for a system that delivers information quickly and efficiently. SBIRS will provide greater sensor flexibility and sensitivity when compared to the Defense Support Satellites.

ALERT, True Innovation for Defense Support Program

As the '90s began and the Cold War ended, the innovative elements characterizing the DSP program then and the Space Based Infrared Systems (SBIRS) Program today was just beginning. As new threats emerged in the post-cold war era, DSP was called upon to support new missions and develop new capabilities.

On 25 February 1991, Dhahran, Saudi Arabia became the site of the worst US loss during Operation Desert Storm when an Iraqi surface-to-surface missile system (SCUD) hit an American barracks, killing 28 soldiers. The US resolved to never allow this to happen again and responded to other lessons learned from Operation Desert Storm, as well as the ever increasing problem posed by proliferation of tactical ballistic missiles. A theater ballistic missile (TBM) early warning capability came to fruition based on prototypical successes achieved by an innovative development project known as Talon Shield. In addition, the Attack and Launch Early Reporting to Theater (ALERT) system was created as a new Air Force data processing system providing enhanced launch warning for tactical ballistic missiles used in theater operations.[5] ALERT began operations in March 1995.

Operating outside the established rules of the strategic missile warning paradigm of "perfect warning," the mission of the ALERT system, operated by the 11 Space Warning Squadron (SWS), was to provide "assured warning" to theater commanders and the warfighter.[6] From an operational perspective, "assured warning" simply meant that if it smelled like a SCUD and looked like a SCUD then the ALERT system reported it as a SCUD. The 11th SWS used data from DSP satellites to detect and track short-range ballistic missiles and rockets. Crews were trained not only to spot these missiles but also the unique flight characteristics of the vehicles. Because TBMs travel such a short distance in a very short time, crews had to quickly spot these missiles, analyze the data, and rapidly transmit this information.[7] By fusing data from a variety of sources, ALERT calculated the best estimate of a tactical missile's path, and immediately sent this information to in-theater warfighter units around the globe. For example, ALERT messages were used to provide warning to targeted theaters, help Patriot missile crews target incoming tactical missiles, or guide aircraft to hunt down and destroy the missile launchers.[8]

Since ALERT maintained a global focus, instead of the localized focus provided by each of Air Force Space Command's (AFSPC) DSP satellites individually, it provided the edge theater commanders needed to protect their personnel. ALERT enhanced the tactical application of AFSPC's warning capabilities using improved DSP sensor data processing to support theater missile defense responsibilities and as a result corrected space operations deficiencies identified during Operation Desert Storm. As a dedicated theater warning system, ALERT improved the exploitation of DSP observations without modifying the spacecraft sensors.[9]

DSP satellites have been updated several times since 1970. The original DSP weighed about 952 kg, had 400 watts of power, 2000 detectors, and a design life of three years. DSP "SED" satellites weighed 1800 kg, had 680 watts of power, 6000 detectors and a design life of five years. The current DSP (DSP-I) satellites incorporated survivability advancements, weigh about 2360 kg, and require 1250 watts of power. Technological improvements in sensor design included above-the-horizon capability to extend hemispheric coverage above the earth's limb and increased on-board data processing capability to improve onboard clutter rejection.

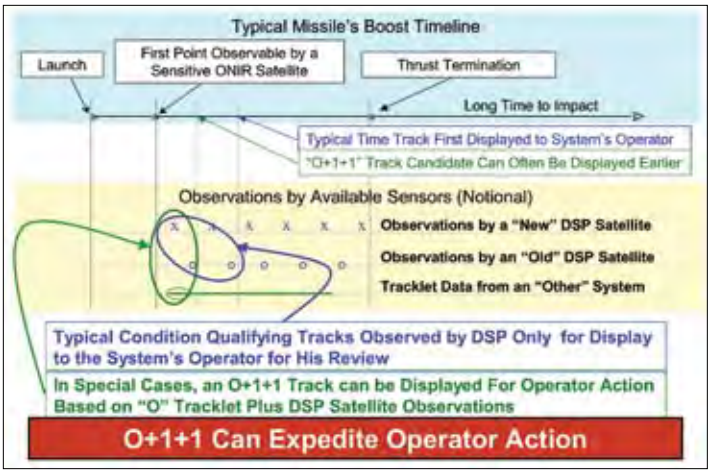
The Innovative Spirit Today in Space Based Infrared Systems

Yesterday's Cold War early missile warning system was supported by a constellation of DSP satellites that have exceeded all performance expectations. DSP made it possible to exploit the economy of data processing centralization, and along with the advances in communications technology have allowed for the support of a new generation of follow-on satellites. All of the ground processing functions were consolidated into a single Master Control Station as the first step ("Increment 1") of the SBIRS program. The ground processing functions consolidated included those from the large processing stations that supported the strategic mission, the ALERT ground system that handled the tactical mission, and the residual satellite state-of health, commanding, and ephemeris-determining functions performed by the Air Force Satellite Control Network. The SBIRS's Increment 1 Ground System took over all mission operations in December 2001, allowing deactivation of the legacy systems.

Today, SBIRS deals with the wide range of strategic and tactical threats confronting the United States by contributing to four major mission areas: missile warning, missile defense, battlespace awareness, and technical intelligence. The spirit that sparked the innovative ground system developments of the DSP era, to better meet the widening range of threats confronting the United States, lives on. The "Try Before You Buy" approach—prototyping candidate improvements for evaluation before implementing them in an operational system—was pioneered by the Talon Shield Project and successfully applied to make ALERT responsive to evolving needs, continues to be applied in rapid prototyping initiatives seeking better ways to exploit real-time spaceborne observations to support our warfighters' needs. A current Rapid Prototyping project goes by the esoteric-sounding name of "O+1+1."

"O+1+1" is a tactical/theater initiative that was conceived during the waning days of ALERT, prototyped in preliminary form during the period when operations were transitioned to the new SBIRS "Increment 1" ground system, analyzed against data collected during Operation Iraqi Freedom, and evaluated to have significant added-value potential. A refined version of this capability, one that will be suitable for direct integration into the operational SBIRS Ground System, is currently under development.

The "O+1+1" nomenclature is technical shorthand used to describe the automatic real-time processing done by the Increment 1 ground system. The expression "X+Y+Z+…" means "X observations from the first of several sources, Y observations from the second, Z observations from a third, and so on" for however many sensors concurrently observe an event. For different situations, different rules are applied by the processing system to determine when to display a track candidate to the system's operators. With "O+1+1," these automatic track display rules are modified for a particular class of events. Here, the "O" (which is the letter O, not the number 0) represents information contributed by an "Other" (i.e., non-SBIRS) source.



The "O" data is in the form of a "tracklet" consisting of early observations that could represent an incipient track, while the two "1"s represent observations from different DSP sensors. Early in an event's history, fusion of both Programs' data is usually necessary to provide an indicator of such a track's reality at an operationally useful level of confidence.

"O+1+1" represents a step forward in mission capability, a pathfinder for future tracking techniques, and a milestone in productive inter-Program cooperation. From the mission point of view, it will make missile launches displayable to operators for earlier action; this can enhance SBIRS's ability to support attack operations (which includes finding and taking out enemy mobile missile launchers that are high-value targets in theater operations) by providing earlier credible indications of possible missile launches. As a pathfinder, the tracking methodology prototyped for "O+1+1" was adopted for SBIRS's future "Increment 2" ground system. Finally, on the programmatic side, "O+1+1" represents a new level of symbiotic payoff from inter-Program cooperation by exploiting real-time observations from dissimilar spaceborne sensors managed by separate organizations to derive events not separately assessable with confidence by either of the contributing systems.

While DSP has been around nearly four decades, providing for the defense of the United States, it should be obvious that the DSP of today is dramatically different from the DSP of 1970. From the technological advancements of the DSP satellite itself, to the innovative tactical applications of ALERT; from the current advancements of rapid prototypes such as "O+1+1," to the imminent deployment of the new SBIRS satellites, space based infrared warning continues to evolve. That innovative spirit is alive and well in the SBIRS program and there can be little doubt from past evidence that further enhancements will be made to ensure the continued security of our great Nation.

Notes:

[1] Official NASA, "Sputnik and The Dawn of the Space Age," NASA History Division, http://history.nasa.gov/sputnik/ (accessed 29 May 2006).

[2] Ibid.

[3] *The Encyclopedia of Astrobiology, Astronomy, and Spaceflight*, "MIDAS (Missile Defense Alarm System)" http://www.daviddarling.info/encyclopedia/M/MIDAS.html (accessed 29 May 2006).

[4] Spaceflight Now, "Defense Support Program," US Air Force Fact Sheet, 26 July 2001, http://spaceflightnow.com/titan/b31/010726dsp.html, (accessed 29 May 2006).

[5] Ibid.

[6] Lt Col Darrell Herriges, *The ALERT Advisor* I, issue 1 (May 1995).

[7] Maj Jeff Maddox, *Guardian*, The Magazine of Air Force Space Command, Apr 1996.

[8] Maj James D. Thorne, *Astro News*, 27 February 1998.

[9] Global Security, Space, "ALERT Space-Based Theater Warning System," Reliable Security, http://www.globalsecurity.org/space/systems/alert.htm (accessed on 29 May 2006).

Capt Scott W. Anderson (BA, Economics, Rutgers University) is the Chief, Space Based Infrared Systems (SBIRS) Software Exploitation, Space and Missile Systems Center, Los Angeles Air Force Base, Calif. He leads a 30 person, 3 site team of military personnel, government civilians, and contractors in developing innovative ground software prototypes with the goal of achieving the greatest potential from the IR data stream and providing enhanced capability to the warfighter.

Captain Anderson began his career as a Satellite Vehicle Operator for Milstar at the 4th SOPS, Schriever AFB, Colorado. Then a Milstar Instructor at the 381st Training Group, Vandenberg AFB, California. He began his present assignment at the Space and Missiles System Center (SMC), Los Angeles AFB, California in May 2003.

Senior Master Sergeant Charles A. Bilbey (MS, Space Systems, AFIT) is Superintendent of SBIRS System Exploitation for the Space and Missile Center, Los Angeles AFB, California. He is a key enlisted leader for the Center. Sergeant Bilbey oversees the development and sustainment of an operational ground architecture that includes strategic and theater missile detection systems in a single operations center. He advises the unit commander in directing, maintaining, and providing support to all assigned enlisted personnel. He provides policy and issues guidance relating to enlisted utilization, training, and qualification in the mission areas of space control and missile warning.

He has held positions as Mission Crew Chief and Operations Superintendent for both the ALERT and SBIRS early missile warning systems.

Theodor ("Ted") Polk is a Senior Project Leader on the Aerospace Corporation's GSE/TI team that has supported the Air Force's Overhead Nonimaging IR Satellite Program Offices (first DSP, now SBIRS) from their inception. He has worked for the Air Force in one capacity or another for 55 years. That included four years of active duty during 1951-55, followed by sixteen years at RAND and System Development Corporation before he joined The Aerospace Corporation in 1971, just in time for the launch of DSP's first operational satellite. During his 35 years as a member of DSP/SBIRS SPO teams, he has had the good fortune to be associated with a variety of innovative projects, including the Talon Shield, ALERT, and SBIRS Rapid Prototyping activities described in this article.

Meeting the Challenge of Space Professional Development:
Developing Expertise from Accrued Experience

Col Edward A. Fienga
Chief, Force Development and Readiness, AFSPC
Peterson AFB, Colorado
Maj Earl J. "Jermaine" Brinson
C4 Hardware Development Lead, GPS Ground Control Segment, Space and Missile Systems Center
Los Angeles AFB, California

As we have progressed down the road of creating the Space Professional Development Program, we have to date implemented singularly significant elements of the program. The challenge that lies ahead is that of integrating the pieces into a collectively synergistic program which capitalizes on each of the components contributing to one's expertise in the space domain—space-related education, training and experience. To do so will require the close collaboration between Career Field Development Teams, Assignment Teams, and the Space Professional Management Office. One such program designed specifically to bring education and experience to a constructive confluence is Air Force Space Command's (AFSPC) Spacelift Education and Crossover Program (SLEC-P).

SLEC-P is a subset of the Air Force Education With Industry (EWI) program sponsored by the Air Force Institute of Technology. The goal of SLEC-P is to support the National Security Space Plan by producing experienced, multi-disciplined (operators, acquirers, mission support) space professionals who can effectively plan, develop, and employ future space systems,[1] with an emphasis in the spacelift mission area. SLEC-P places highly qualified officers into work positions with major space contractors (i.e., Boeing and Lockheed Martin). These officers learn contractor operations firsthand from inside the organization and then transition to an assignment working with the programs with which they have gained intimate knowledge. The benefits for both the Air Force and industry are readily apparent: officers with enhanced management qualities and technical expertise who understand industry's objectives, problems, and modes of operation.[2] SLEC-P is designed to help ensure that the Air Force remains fully engaged in the acquisition and operation of spacelift vehicles—a critical contributing element to our ability to control the high ground.

The article that follows is the personal account of the SLEC-P experience from one of the command's SLEC-P "graduates," Maj Earl J. "Jermaine" Brinson.

The Challenge

It is a long held military axiom that in order to be successful at warfare, one must control the high ground. There is no higher ground than space. Proper planning, development, and employment of our space-based capabilities are critical to our Nation's war-fighting ability. Recognition of the criticality of space and an honest assessment of how we utilize space assets has led to the need to "Develop and maintain a sufficient cadre of space-qualified personnel to support their Component in space planning, programming, acquisition, and operations."[3]

The process to create a space professional cadre has been building for several years. Emphasizing the importance of the space professional to preserving national security was directed in many areas:

- *The Report of the Commission to Assess United States National Security Space Management and Organization* (Space Commission – January 2001) directed, "… create and sustain a cadre of Space Professionals and … create a stronger military space culture through focused career development, education and training, within which the space leaders for the future can be developed."
- The former Chief of Staff of the Air Force General John P. Jumper, *Chief's Sight Picture* (6 November 2002) outlined a new vision called Force Development. It is executed across all specialties in the Air Force, "… focusing on training, education, and experience programs … especially how personnel are assigned to get that experience." Each development program is designed "… to ensure that your experience emphasizes a breadth of exposure to the Air Force mission while focusing on the depth of experience you need to be good at your job."
- General Lance W. Lord, retired, then Commander of Air Force Space Command (AFSPC), *Space Professional Strategy* (April 2003) laid out the vision for building and sustaining a national security team of space professionals. This vision includes identifying the population of space professionals by analyzing the expertise required to take space and missile systems from concept to employment, with the objective of better preparing them through space education and training; and improving the career development processes through education, training, and job experience.
- *The National Security Space Plan* (May 2003) outlines a desired capability to have experienced, multi-disciplined space professionals. Experienced, multi-disciplined (operators, acquirers, mission support) space professionals are essential in maintaining our advantages in space capabilities in the future. Their skills will be needed to fully integrate space capabilities into operational campaigns while effectively planning, developing and employing future space capabilities.
- The Department of Defense Executive Agent for Space

(DoDD 5102.2) was issued June 2003. It instructs, "Develop and maintain a sufficient cadre of space-qualified personnel to support their Component in space planning, programming, acquisition, and operations."[4]

A Frontline Example

I had been assigned to Patrick AFB, Florida as a Titan IV spacelift operator for a little over two years when I was selected in February 2004 to participate in SLEC-P. I was assigned to Boeing's Huntington Beach, California site for a ten month EWI tour of duty. The Huntington Beach site is the hub of the Boeing Delta Space Launch Program's engineering, quality, program management, and business operations. The Delta Program is responsible for building, launching, and managing the Delta family of launch vehicles. To guide the SLEC-P EWI experience, I worked with the AFSPC and Boeing SLEC-P coordinators to develop an extensive work plan designed to maximize the benefits from this assignment by rotating me into the major sections of the organization to learn their modes of operation. Assignment areas and learning objectives were established based on personal interests and items of high interest to the Air Force. It was a tiered approach beginning at the higher levels of management and then proceeding to the lower level functions driving day-to-day operations.

I began with program management which introduced me to the program and sub-contract management processes and to the various issues facing the program. This was a view from the top; achieving the real goals of SLEC-P, however, would require much more in-depth involvement.

To truly understand how management operations worked I needed to observe the process in action and interact with it. To this end, I was assigned as a project manager with the Delta Cryogenic Second Stage Integrated Process Team.

Mission: Develop a configuration of the Delta Cryogenic Second Stage Liquid Hydrogen (LH2) forward skirt pneumatics panel components that could withstand the anticipated temperature extremes generated by certain types of launch profiles. Mission accomplishment required a team of engineers, supplier management and procurement, manufacturing and assembly, and supplier personnel with the support of upper level management.

Responsibilities: My job was to coordinate the efforts of the diverse team in developing and executing a schedule that included all the required tasks for modifying, procuring, testing, and installing the hardware, and insuring the project stayed on schedule in order to meet launch requirements.

Process: We first had to determine a configuration that would meet the requirements and then lay out all the tasks required to implement it. Next we had to determine all the dates of the applicable launch vehicle processing milestones such as launch, wet dress rehearsal, spacecraft mate, and so forth that would drive our project's schedule of events. We had to present our plan to upper management and request the funds required for implementation. We had to work closely with the Boeing subcontractors who would be providing the required hardware. Their flexibility, expertise, and timely responses to our requests were crucial to on-time project completion.

The project required a systems engineering approach. At times we had to deconflict and synchronize our actions with other redesign/rework activities. Although an upcoming Delta IV mission was the primary schedule driver, future missions and different hardware configurations had to be addressed as part of our design and planning. Because of the rapidly approaching launch that would require the new configuration, our schedule was very aggressive. We had to continually break tasks in to smaller units to better manage their timely completion. The engineers had to learn the supplier management requirements so that realistic estimates could be established for completing each task. Supplier management, in turn, had to learn the engineering change process to facilitate task scheduling and completion. Simultaneous processing and proactive measures to expedite activities as required between supplier management, manufacturing and assembly, Boeing and supplier engineers were the keys to success.

Outcome: The team successfully redesigned, reworked, retested, procured, and installed the necessary new hardware in time to support the scheduled launch date. New component qualification limits and design specifications were established and made applicable to the entire fleet of Delta IV vehicles.

Delta IV.

Benefits: I learned Boeing's engineering change, procurement, configuration control, budgeting and finance, and quality review processes. I gained a deeper understanding of the issues and challenges facing the Delta program specifically and the spacelift industry in general. I had an unshielded look at Boeing's subcontract management and systems engineering processes. The inherent complexities and intricacies of the assignment greatly enhanced my project management skills. The detailed knowledge of Boeing's internal workings and personal relationships formed through working as a project manager and rotating through other areas of the program will be an invaluable resource for ensuring Air Force spacelift needs and requirements are met and in helping the Air Force remain fully engaged the evolved expendable launch vehicle (EELV) process.

The Future

The Air Force EELV program is aimed at reducing space launch costs. One of the key cost-reducing strategies is outsourcing the manufacture of flight hardware to qualified subcontractors when appropriate.[5] As a result, one of the biggest challenges facing the Delta Launch Program is subcontract/supplier management. In order for Boeing to ensure adherence to government specifications and requirements, it must effectively manage its suppliers. How well Boeing does at this task is of great importance to the Air Force. The Air Force will require dedicated, experience space professionals working closely with Boeing personnel to meet this challenge.

Continued success of Space Professional Development will hinge on the training and experience provided by programs such as SLEC-P. Careful analysis of potential areas of concern, such as the aforementioned subcontractor management issue, must be conducted and incorporated into the work plans for future program participants. Space Professional Development is the vanguard for maintaining our advantages in space capabilities and SLEC-P is one of its most important frontline programs.

Notes:

[1] DoD Directive (DODD) 5102.2, *DoD Executive Agent for Space*, 3 June 2003.

[2] Maj Greg Wood (HQ AFSPC/XORS) and Maj D. Hamilton (HQ AFSPC/XOTT), Space Professional Development Spacelift Education and Crossover Program (SLEC-P), 20 September 2005.

[3] National Security Space Plan, May 2003.

[4] Spacelift Education With Industry (EWI) Road Show, 11 August 2003.

[5] DELTA IV Self-Study Guide USAF Evolved Expendable Launch Vehicle; Module 1 Delta IV Overview and Launch Site Facilities, The Boeing Company, 29 March 2002.

Col Edward A. Fienga (BS, The Citadel; MA, Webster University) is the Chief, Force Development and Readiness, Headquarters Air Force Space Command, Peterson AFB, Colorado. He is responsible for assignments of the Air Force Space Command's officer and enlisted space operators and space acquirers as well as the development, implementation and funding of the Air Force Space Professional Strategy to include education, training, and certification development. Colonel Fienga was commissioned through the ROTC program in May 1986. He has held a variety of operational and staff duty positions from the squadron to the Air Staff levels. He has controlled air activity as an Airborne Weapons Director on the E-3A Airborne Warning and Control System (AWACS), accumulating over 750 flight hours; operated the PAVE PAWS ground-based radar and commanded the 321st Missile Squadron at Francis E. Warren AFB, Wyoming. Colonel Fienga is a graduate of Squadron Officer's School, the Legislative Fellows Program (IDE) and the Belgian Defense College (SDE). He is a Command Credentialed Space Professional.

Maj Earl J. "Jermaine" Brinson (BS, North Carolina Agricultural and Technical State University (Cum Laude); MS, Industrial Engineering) is currently assigned to the Space and Missile Systems Center (SMC), GPS Ground Control Segment at Los Angeles AFB, California as the C4 Hardware Development Lead. In previous assignments, Major Brinson has operational experience in the 319th Missile Squadron (Assistant Flight Commander), 90th Operations Group (Missile Combat Crew Commander and Chief, Standardization/Evaluation Scripts Development), and 3rd Space Launch Squadron (OSS Spacelift Training Flight). He was chosen for the highly competitive Spacelift Education and Crossover Program (SLEC-P), as one of only five Air Force officers selected, he joined the Boeing Corporation in Huntington Beach, California. He earned his commission through Officer Training School, Maxwell AFB, Alabama. Major Brinson is a graduate of Squadron Officer School at Maxwell AFB.

Book Review

Thunder over the Horizon: From V-2 Rockets to Ballistic Missiles

By Clayton K. S. Chun. Wesport, Connecticut: Praeger Security International, 2006. Maps. Photographs. Illustrations. Appendix (Tables). Bibliography. Index. Pp. xi, 221. $49.95 Hardcover ISBN: 0275985776

For a long time, novices to the history of military technology have needed a basic overview of the development and use of ballistic missiles worldwide since the 1940s. Clay Chun's *Thunder over the Horizon* fulfills that need. When the publishers at Praeger Security International asked him to write a reference volume to help relatively uninformed readers understand how missiles work and when they were used in combat, Chun accepted their offer on the condition he could address related issues. Specifically, the former US Air Force missile launch officer, Air Staff strategist, and current head of distance education at the US Army War College wanted to explain the impact of missile technology on national strategies, doctrine, force structure, and politics. The result is a fairly comprehensive synthesis of information extracted from secondary sources and aimed at a general audience.

Thunder over the Horizon begins with a chapter on the fundamentals of ballistic missile design and operation. Chun explains how missiles are classified according to their ranges. For the lay reader, he describes the three distinct flight phases—boost, midcourse, and terminal—of a missile moving from its launch point to the intended target. Next, he identifies several common missile components or subsystems: airframe, propulsion, guidance, control surfaces, and warhead. He matches an especially lucid elaboration on liquid- and solid-propellant systems with a clear explication of challenges associated with building guidance and reentry systems. Despite such challenges, an increasing number of countries around the world are obtaining long-range missiles, either through indigenous technological capabilities or by purchasing them from a foreign supplier. Such proliferation raises the specter of new arms races, nuclear blackmail, sudden preemptive attack, and expansion of regional conflicts into global crises.

Having expressed this concern, Chun devotes four chapters to narrating the use of ballistic missiles during international conflicts. As the book's subtitle indicates, the history logically begins with German V-2 rocket development and launches against England, France, and Belgium during World War II. Introduced too late to stop the advancing Allies, the V-2 caused panic and damage on a local level but failed to demoralize England as a whole. Nonetheless, the V-2 demonstrated that rockets could deliver warheads over hundreds, perhaps thousands, of miles. This capability, combined with dramatic technological advances that allowed reduction in the size and weight of nuclear warheads, compelled the Cold War superpowers to begin developing intermediate-range, intercontinental, and submarine-launched ballistic missiles. *Thunder over the Horizon* explores the military, political, and economic impact of the resulting missile race.

The author devotes two chapters to case studies of confrontations involving ballistic missiles: the Cuban Missile Crisis (1962); the Iran-Iraq War (1980-88), including the so-called War of the Cities (1988); and Operation Desert Storm (1991). Out of the Cuban Missile Crisis came a mutual awareness that US and Soviet leaders should step away from direct nuclear confrontation and rely more on negotiations, but the crisis also highlighted Soviet intercontinental ballistic missile (ICBM) inferiority and drove the Soviet Union to expand its ICBM development. In the Iran-Iraq War, especially the War of the Cities, missile attacks hastened a cease-fire by straining Iran's economy and destroying the morale of its citizens to the point where Tehran's strategic position unraveled. During Operation Desert Storm, a new aspect of missile warfare emerged with the allies' active defense against Scud missile attacks and a campaign to target Iraq's mobile launchers. For North Korea and others, however, the Iran-Iraq War and Operation Desert Storm highlighted how missile operations by a country with more and better missiles than Iraq might achieve long-range power projection beyond the battlefield.

Chun concludes with three chapters covering the proliferation of ballistic missiles, their effect on US policy and strategy, and the impact of missile technology on military organization and operations. He explains the concerns arising from proliferation and explores the potential strengths and weaknesses of such options as arms control agreements, economic accords to limit international arms trafficking, and active or passive defenses to address those concerns. On the subject of national policy and strategy, he reviews the evolution of deterrence in the Cold War. Cautioning that deterrence assumes the presence of rational actors, he questions the validity of such an assumption where nations like Iran and North Korea are involved. Finally, he suggests how a complex web of technological advances, with ballistic missiles at its center, has changed military planning and might even be blunting the airpower advantage currently possessed by the United States.

Despite occasionally awkward phraseology and a noteworthy blunder in proofreading—"Gather" (pp. 76, 77, 215) instead of Gaither Report—Chun's primer on ballistic-missile history offers those unfamiliar with the subject a rich starting point. As for the experts, *Thunder over the Horizon* supplies a wealth of thought-provoking analysis from which to generate hours of healthy discussion.

Reviewed by Dr. Rick W. Sturdevant, Deputy Command Historian, HQ Air Force Space Command

We are interested in what you think of ***High Frontier*** and request your feedback. We want to make this a useful product to each and every one of you as we move forward in the development of our space professionals and to stimulate intellectual thought. Please send your comments, inquiries and article submissions to: HQ AFSPC/PAI, High Frontier Journal, 150 Vandenberg St, Ste 1105, Peterson AFB CO 80914-4020, Telephone: (719) 554-3978, Fax: (719) 554-6013, Email: afspc.pai@peterson.af.mil, To subscribe: nsage@colsa.com

U.S. AIR FORCE

AIR FORCE SPACE COMMAND

AFSPC/PAI
150 Vandenberg St.
Ste 1105
Peterson AFB, CO 80914
Telephone: (719) 554-3978
Fax: (719) 554-6013

For more information on space professional development visit:
www.peterson.af.mil/spacepro

Air & Space Power Journal:
www.airpower.maxwell.af.mil/airchronicles/apje.html